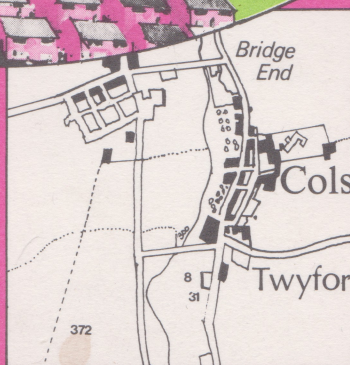
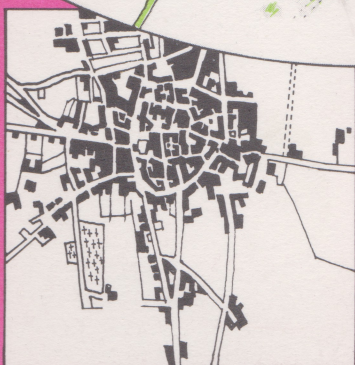
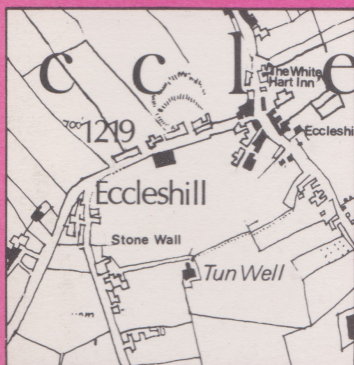
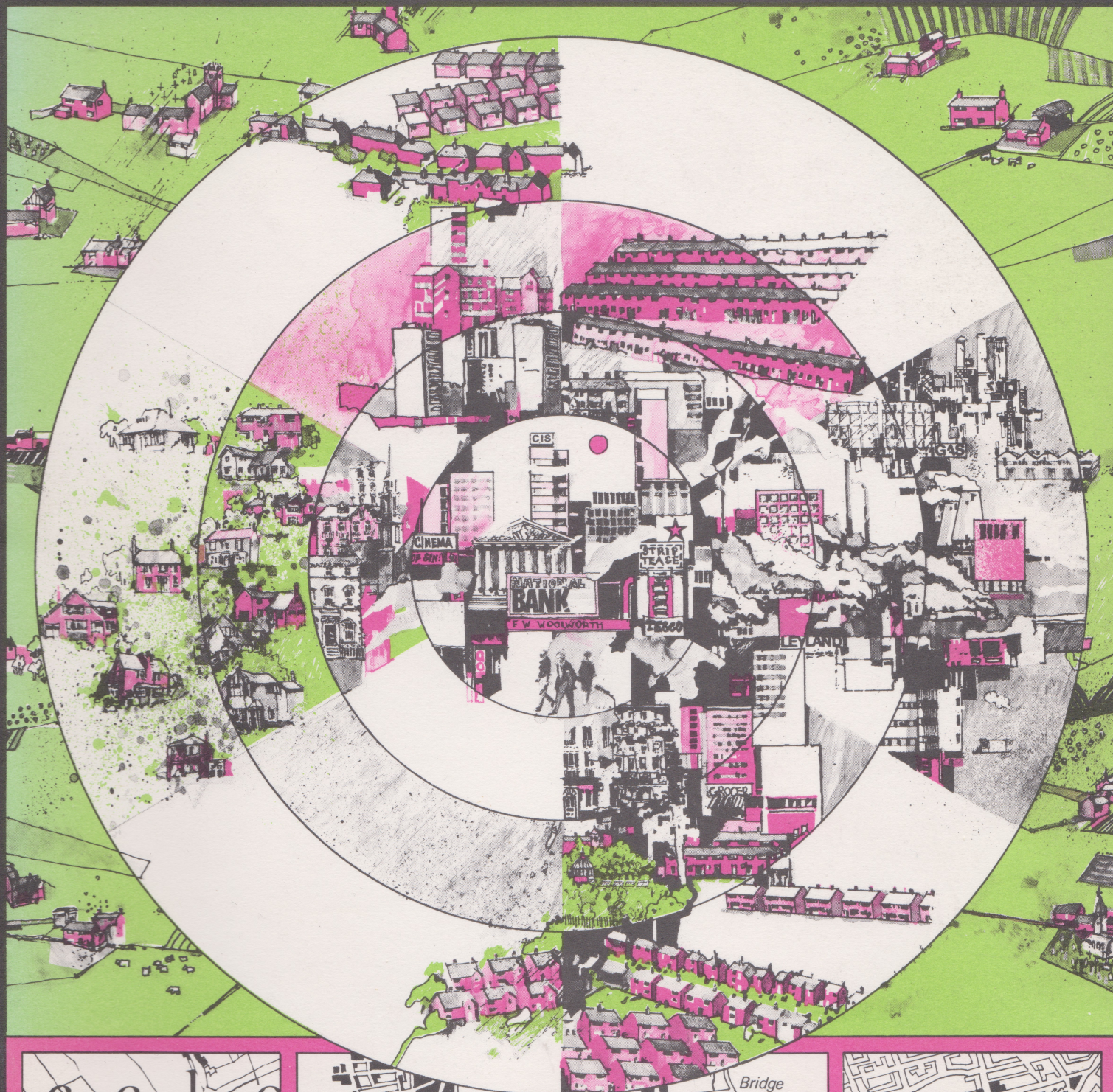




Spatial Aspects of Society





THE OPEN UNIVERSITY

UNDERSTANDING SOCIETY: A FOUNDATION COURSE UNITS 19-22

Spatial Aspects of Society

THE OPEN UNIVERSITY PRESS

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INTRODUCTION TO UNITS 19-22

The four units (19-22) which you are now about to study have a number of factors in common. To begin with, they are all concerned with geography as a social science. But more than that, they introduce some of the basic concepts that occupy the minds of geographers today, not only in the agricultural, industrial and urban branches of the subject, but also in the wider field of settlement pattern analysis.

In all four units the same methodological approach is employed, for in each one a geographical proposition is set out in the form of a basic model. Each model is a simplification of reality and being therefore free from the confusing detail that reality brings, it permits a clearer understanding of what is of fundamental importance. First, a model devised by Heinrich von Thünen explains the relationship between the way the farmer uses his land and the urban market. Then Alfred Weber's model of industrial location attempts a rationalisation between factors of production and markets. Next models devised by E. Burgess, H. Hoyt, C. D. Harris and E. L. Ullman, explain the way land is used in urban areas; and finally, Walter Christaller's model seeks to relate central places to their regions of rural hinterlands. All the models are then critically examined and evaluated against the empirical field evidence of research workers, that is, against the complexities of the real world as we know it.

It is to be hoped that you will find this common approach to our units of value in your understanding of this particular section of the course and that it will also provide you with an introduction to the way in which human geographers are currently approaching their task of analysing the spatial aspects of economic and social phenomena.

SUPPLEMENTARY MATERIALS (bound separately, and at present available only to Open University students)

Self-assessment tests
Computer marked assignments
Tutor marked assignments
Radio notes
Television notes
Notes on the correspondence material

THE SET BOOKS

Understanding Society.^{*} Readings in the Social Sciences edited by the Social Sciences Foundation Course Team. London, Macmillan (1970).

Rural Settlement and Land Use by M. Chisholm. London, Hutchinson (1968).

Industrial Activity in Economic Geography by R. C. Estall and R. O. Buchanan. London, Hutchinson (1966).

Towns and Cities by E. Jones. Oxford, Oxford University Press (1966).

^{*} Referred to in the text as the *Reader*

Unit 19

Rural Land Use



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RURAL LAND USE

1 LOOKING AT AGRICULTURAL LAND USE

Until quite recently attempts made by geographers to explain rural land use patterns had mainly been in terms of establishing a direct relationship between types of agricultural activity and factors of the physical environment, with the inevitable result that economic principles had been largely ignored, and that work in the field had remained essentially descriptive. Although the French school of human geography as exemplified by Sorre (1962, pp. 399–415) gave attention to other aspects of agriculture and emphasised the nature of farming as a ‘way of life’, only in the past few years has the present writer (1966) and others working in the field emphasised that – since modern agricultural production is mainly oriented towards market demands – it is necessary to comprehend economic principles in order to explain agricultural land use patterns, as well as to appreciate objectively other non-economic influences at work in producing these patterns.

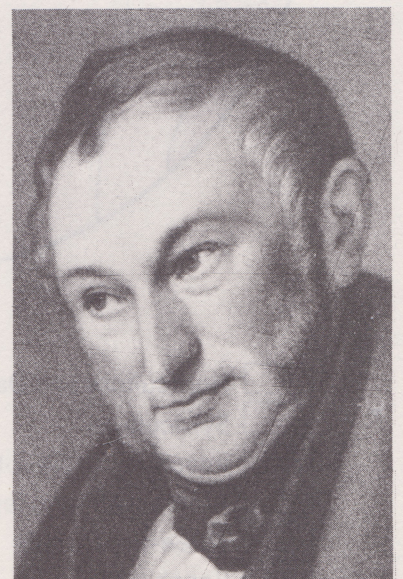
2 A LAND USE MODEL

In order to demonstrate the economic base of rural land use patterns it is useful to consider an agricultural location model. A number of these exist using as their central theme the concept of *economic rent*. The economic rent of a particular piece of land represents the net return yielded additional to that from land at the economic margin of farming. It should in no way be confused with the rent paid by a tenant farmer for the hire of his land from a landlord. Two men, Ricardo (1817) and von Thünen (1826) established this concept as early as the 1820s, but their individual approaches were very different.

Ricardo recognised a fundamentally important point in seeing that variations in soil fertility would lead to variations in land use and that this would result in differences in economic rent. On the other hand, von Thünen in the first instance assumed soil fertility to be constant and the main variable cost to be that of the transportation of agricultural produce from farm to market. It followed that the type of land use and the intensity of cultivation were functions of distance from the market, and as a result a series of concentric belts of differing land use were created around the market centre. It was von Thünen’s emphasis on spatial relationships which has led geographers in the past few years to use and develop his model rather than that of Ricardo. You would expect this from your work on Unit 4. Before the mid 1950s however, geographers had neglected von Thünen’s model, not least because the importance it attached to transport costs seemed less justified in the twentieth century, as these had become of reduced relative importance. Also some of von Thünen’s simplifying assumptions seemed to lack reality. Was it reasonable to assume, as he had done, an isolated state with a single central market and a uniform transport network operating on a plain of soils of uniform fertility?

Nonetheless, the model does deserve our attention for at least two

Figure 19.1 Heinrich von Thünen.

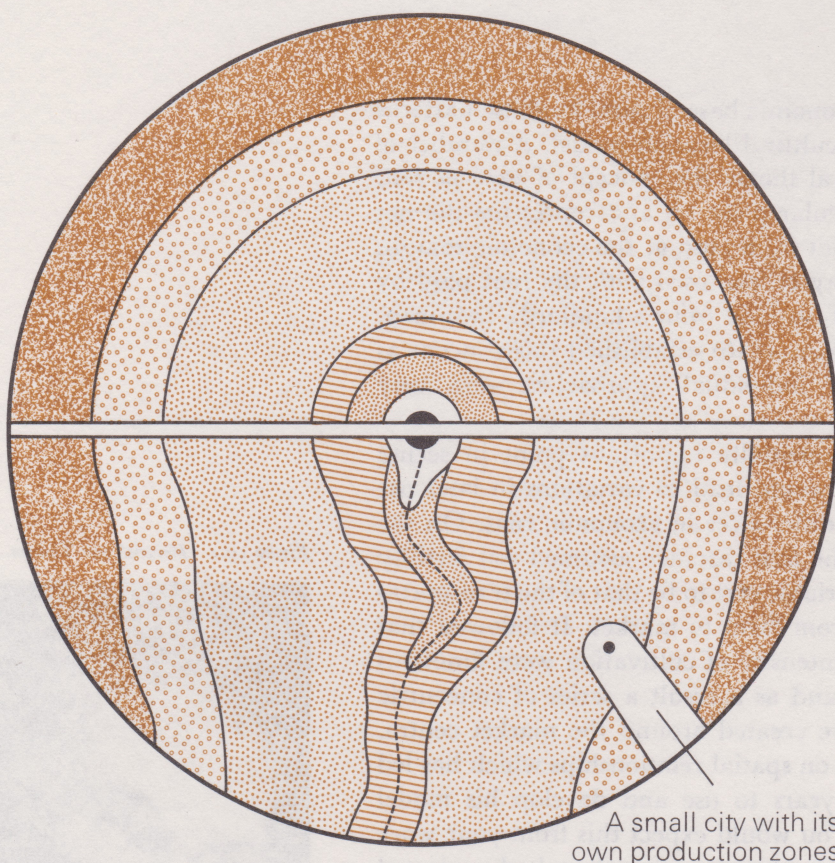


good reasons. First, it can explain contemporary land use patterns around villages and farms in many parts of the world, although at this scale it is the labour cost incurred by the time spent travelling from farm-house to field that is most significant. It can also explain how agricultural land uses can be disposed about very large urban markets even at supra-national level. Second, the model represents an attempt to obtain a theoretical explanation of land use patterns and although modified by von Thünen himself, as well as by other workers in the field, his fundamental distance-cost relationship remains to a large extent a valid one. If you have not already done so you should now read pages 289–93 in the *Reader* which deals in detail with the basic von Thünen model.

3 ASPECTS OF THE VON THÜNEN MODEL

3.1 Inside the Farm

One aspect of the von Thünen model receives little attention in that part of the *Reader* which deals with the basic model. The account of Andreas Grotewald which is quoted in the *Reader* is written in terms of the best way to conduct the farm as a unit, given its location, and the pattern of agricultural zones which arises as a consequence.



-  Horticulture and Dairying – no fixed rotation
-  Sylviculture
-  Intensive arable rotation
-  Arable with long ley
-  Three-field arable
-  Ranching

- Central city
- Navigable river

Figure 19.2 Von Thünen model of Agricultural Land Use.

However, von Thünen explicitly observed that exactly the same argument applies to the distribution of agricultural enterprise inside the farm and he devoted a good deal of space to looking at the problem at this scale. The farmer is aware of the price he will get for any product at the farm gate, for it is the market price less the cost of taking it to the market. This is the local price at the farm buildings which form the centre of operations for the farm. The fields which lie far away from these buildings incur higher costs of operation than the nearer ones because of the greater amount of time spent in travelling to and from them. If the distance is great enough, there will be no profit in cultivating a particular crop in the more distant fields and at a certain distance from the farmstead, the cultivation of that crop will stop. Looking at it another way, the returns to be had from some other crop will become greater at a particular distance from the farm complex. It could be that potatoes are grown on the fields close by the buildings whilst wheat is grown further away. Further, the intensity with which each crop is grown will fall as the distance from the farm complex increases. Thus the farming system will vary from one part of the farm to another and thus there will be a zoning of land use which repeats certain aspects of the zoning found at larger scales.

Von Thünen noted from these observations that there were four main consequences. First of all, the farmer should look at the costs of cultivating each field and the returns got from it and try to arrange the pattern of cropping so as to maximise returns from each field. Secondly, that for any type of farming system there is an optimum size; farm size is therefore related to location, this being one of the determinants of farming systems. Thirdly, the distance from the central city at which a crop ceases to be grown is affected by the distance within the farm from the farm buildings to the field in which it is grown. For example, near the central city wheat may be grown on the furthest fields of the farms. Further away from the city, the economic rent yielded by wheat will be less, but farmers may choose to compensate for this by reducing their production costs. They could do this by growing wheat on fields nearer the farm centre which, because they are closer, have lower costs of cultivation. In this way the belt of wheat production could be extended beyond the limits it would otherwise have.

Finally, there is a consequence which is important to the question of reorganising farm holdings in the interests of lower costs. Farms are often not compact units but are fragmented, with numerous parcels lying at different distances from the farm buildings. A parcel may be so far away from the centre of operations that only a low economic rent may be yielded. If this parcel lies nearer another farmer's building, it may possess a higher potential economic rent for the second farmer. If an exchange can be effected which reduces the average distances from farms to fields in each case, then the economy of both farms will be improved. This important benefit of farm consolidation comes straight from location principles.

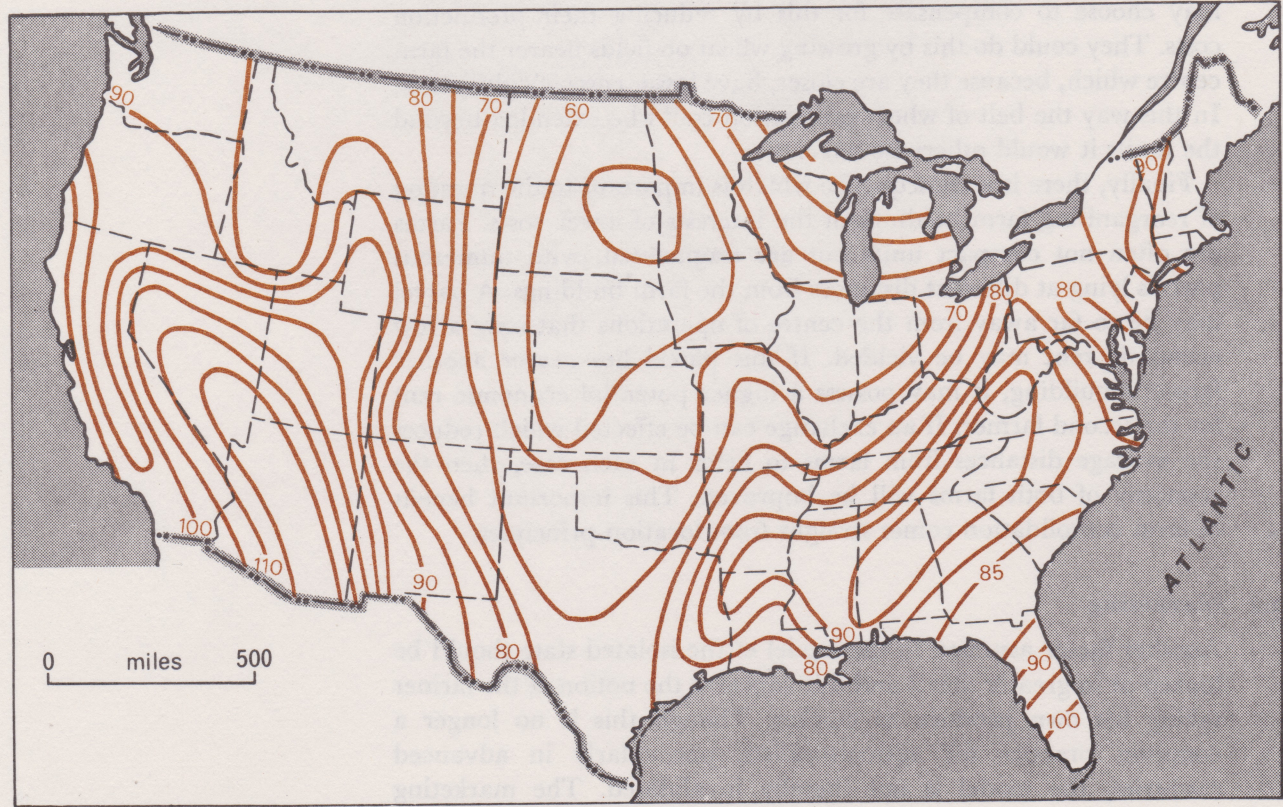
3.2 Marketing

Another factor assumed in the model of the isolated state should be looked at in greater detail and this concerns the notion of the farmer taking his own produce to market. Though this is no longer a common practice for agriculturalists, particularly in advanced countries, the model is not thereby invalidated. The marketing

concept is just as valid if we assume that the farmer sells his produce to another party who then disposes of it. However long a chain of middle men before the final dealer, the price of a commodity at any particular point may be looked upon as fixed and beyond local control. For example, if we take it that, in the case of wheat, the price in terms of international trade is decided by the main world market, that is western Europe which takes over 50 per cent of world imports, then at Sydney the price is determined by the European price minus the transport costs of carrying the grain to Europe. Such a port would be supplied from elevators in the interior, which in turn would derive their supplies from farms. At each point in the movement of the wheat, price is related to that which can be got from the next higher stage of marketing minus the handling costs and dealers' profit margin. The practical working out of this chain of reaction can be seen in a series of maps compiled for the United States based on average prices obtained for farm products for a number of years. (United States Department of Agriculture, 1953.) These show strong regional differences which inevitably spring from several causes, but more particularly, from transport costs. (See Figure 19.3 (a) and (b).)

More often the principle we have outlined is altered by pricing policies which tend to average out prices on a regional basis thus affecting some of the relative advantages conferred by certain locations within such an area. This point is demonstrated by Alexander with regard to transportation costs as can be seen in the *Reader* (pp. 293-6) where he discusses freight rates levied by the railway on goods, with particular reference to the 'stepped' gradients radiating from the city of Milwaukee. The *Reader* goes on to make the point that the modest regional variations in prices received by British farmers for liquid milk do not reflect fully the differences in the costs of collection and disposal; the actual farm gate price being nearly uniform over the country (p. 297). Such pricing policies of

Figure 19.3 (a) Regional variations in prices received by farmers (1925-1934) in the U.S.A. (i) Corn.



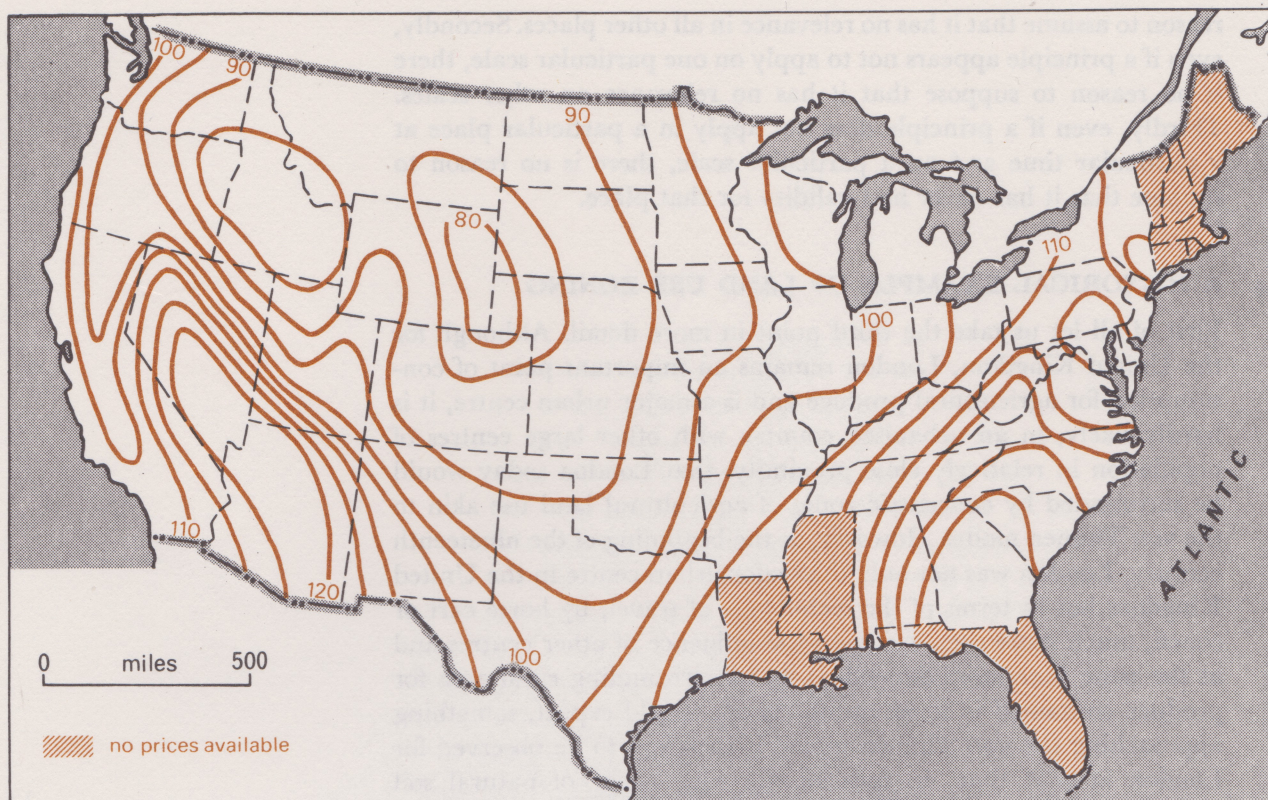


Figure 19.3 (b) (ii) Wheat.

course do not prevail for all agricultural goods and, even where they do, there remain certain points in the marketing chain around which zoning will take place, at a micro or a macro level. This is in spite of the fact that the complexities of the contemporary real world situation are manifold compared with the simplicity of the original von Thünen model. Extracts in the *Reader* make clear not only the effect of transport pricing policies, but also the importance of soil variations and other physical factors (J. J. Hidore, pp. 297–301), the influence of modern technology, and the attitudes and assumptions of the individual farmer whose aim may not be the maximisation of profits (Julian Wolpert, pp. 302–12).

Perhaps it should be added here that both the Hidore and Wolpert articles in the *Reader*, but more particularly the latter, contain explanations of their methodological approach to their research which may be difficult for you to understand. You should not feel concerned about this at the present stage in your studies, since it is enough that you appreciate the basic ideas that they put forward.

3.3 Some Mistaken Criticisms

The severest critics of the original model have argued, however, that all else apart, von Thünen's assumption of a single city without any contact with other urban areas is sufficient to invalidate the model. They accept that he subsequently admitted the introduction of a few competing centres of consumption but believe that in the real world, the number of urban centres interacting one with another becomes so great and the interplay of production zones so complicated, that his principle is vitiated. Further, they argue, transport differences have become negligible and other factors have assumed predominance. What has been said so far here and in the *Reader* must surely indicate the mistakes in these arguments. First of all, even if a principle appears not to apply in one place, there is no

reason to assume that it has no relevance in all other places. Secondly, even if a principle appears not to apply on one particular scale, there is no reason to suppose that it has no relevance on other scales. Thirdly, even if a principle does not apply in a particular place at a particular time and on a particular scale, there is no reason to suppose that it has never had validity for that place.

4 A HISTORICAL EXAMPLE OF LAND USE ZONING

First of all let us take the third point in more detail. Although for the United Kingdom, London remains an important point of consumption for agricultural produce and is a major urban centre, it is hardly likely, in an urbanised country with other large centres of population in relatively close proximity, that London today would be surrounded by concentric zones of agricultural land use akin to the von Thünen model. However, at the beginning of the nineteenth century, London was not only the major urban centre in the United Kingdom but in terms of the technology of travel, by horse cart or coach, much more removed from the influence of other centres and at the same time more dependent on its surrounding rural area for produce consumed in its environs. As one would expect, something approaching the von Thünen model is therefore to be observed for London at that time, in spite of the wide range of natural soil conditions in the surrounding area, ranging from the intractable clays of Essex and Middlesex, to the light fertile loams on the river gravels to the thin but readily worked soils of the chalk uplands. Thus the Reverend Henry Hunter, writing in 1811, was able to describe the land around the capital in terms of a series of concentric belts, each displaying a measure of unity in terms of farming practice. G. B. G. Bull (1956, pp. 28–30) has summarised Hunter's writing quite succinctly and in doing so, has attempted a comparison with a map of the land use zones of London made at two inches to the mile by Thomas Milne in the year 1795. (See map, Figure 19.5.)

The zone of clay-pits—The urban nucleus was surrounded, according to Hunter, by a zone in which 'the face of the land is deformed by the multitude of clay-pits from which is dug the brick-earth used in the kilns which smoke all around London'. At night, a 'ring of fire' and pungent smoke encircled the City. The excavations for brick-earth associated with the Taplow Terrace of the Thames, had a short life but yielded great profit. It was customary to remove the top four feet of brick-earth, manufacture bricks on the spot at the rate of four million per acre, and then to fill without delay the cavity with a mixture of rubbish, manure and top soil so that the site could be used for building, for pasture or crops. The scale of Milne's maps allows few pits to appear, but large unfilled ones may be seen near Mile End and in Southwark. The words 'Gravel Pits' are printed across the district north-west of Kensington Palace.

The zone of cattle pastures—A kind of Green Belt ring, or as Hunter describes, 'a green and open tract which gives a pleasing rural character to the immediate vicinity of the town', surrounded the innermost zone of clay and gravel pits. The zone was widest north of the Thames, where it extended for three miles from the line where London Clay first emerges from its covering of river-terrace gravels to the foot of the Hampstead-Highgate ridge. South of the river, gravel-capped spurs, such as Blackheath,

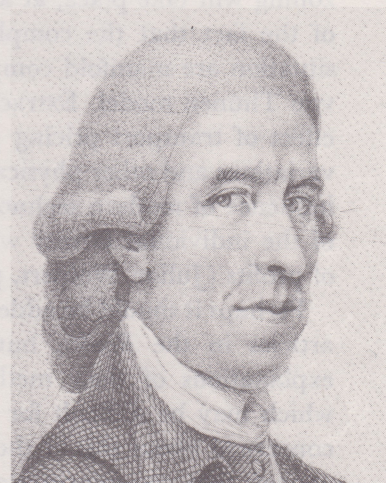


Figure 19.4 Rev. Henry Hunter.



Figure 19.5 Section of Thomas Milne's 'Plan of the Cities of London and Westminster, 1800'. Scale two inches to one mile.

Wandsworth and Wimbledon Commons, capped by grasslands of lower quality, restricted the width of the pastoral zone, but expanses of alluvial meadowland were found in the Lower Wandle Valley, near Dulwich and also west of Deptford. The pastoral zone was 'almost entirely in the possession of the cow-keepers who provide the metropolis with milk'. The dairy-farmers manured the meadows to maintain a supply of fresh grass until mid-winter and then fed their cattle in the stall with turnips, hay and brewer's grains until the spring flush of grass was ready.

Beef cattle were mainly found on drained marshland pastures in the Lower Lea Valley, the Rotherhithe area and the Isle of Dogs. Milne's map shows the excavations for the West India Docks which had newly separated the Isle of Dogs from the mainland, and the eight newly built windmills which lifted water from the drainage ditches of an area famed for the size of its beasts.

The zone of market gardens – Hunter describes a belt of market gardens and nurseries bordering the Thames and therefore breaking the continuity of the concentric arrangement of zones. The belt extended from Bow, east of London to Hampton about fifteen miles to the west. Milne's map shows that the belt conformed to the width of the outcrop of Flood Plain Terrace Gravels of the Thames and Lea Valleys. The core of the market-garden belt lay in the parishes of Isleworth and Brentford, where orchards of apples, pears and cherries yielded an 'upper crop' with an 'under crop' of strawberries and raspberries planted between the trees. The orchards were surrounded with high walls, on which peaches, plums and nectarines were trained. Round the core,

Hunter found three sub-divisions of the market-garden belt in which other crops were equal in value to fruit and vegetables. The first of these, the river-banks and islets between Fulham and Staines, had numerous osier-beds for basket- and sieve-making. The second, in the parishes of Fulham, Hammersmith and Chelsea where the persistence of open-field cultivation made specialised cultivation difficult, grew large quantities of barley and wheat in rotation with vegetables. The third, the western end of the market-garden belt in Twickenham and Hampton, had a distinctive character owing to the many parks and pleasure grounds which stood among the market gardens. The hot-houses of gardens such as those of Hampton Court, Osterley Park and Syon House produced exotic fruits such as pineapples, apricots and grapes.

The zone of hay – The outermost zone, according to Hunter, was chiefly devoted to growing hay for sale in the London market. The best hay meadows were the drained marshes of the Lea Valley of natural grass freely manured so as to yield two crops in each year. These were more productive than the high meadows on the glacial and other drift deposits crowning the ridges at Finchley, Harrow and Hendon, which were artificially sown with rye-grass and yielded only one crop a year. The remoter parts of the hay-growing zone, where hay could be profitably sold only in favourable seasons, practised ley farming with clover and grass taking their turn with grain crops.

The hay zone of north Middlesex gradually merged into the market-garden belt adjacent to the Thames by way of a transitional area of mixed farming in which there was a slight preponderance of arable land. This wedge-shaped transitional zone, broadening westwards from Acton through Ealing to Hanwell and Uxbridge, contained areas which since Elizabethan times had been famous for their grain, such as Heston for wheat and northern Chiswick for barley. The river-terraces of the River Brent, and the many outliers of Lower Tertiary loams give the soils in this zone a lighter character than the heavy London Clays to the north and south of it. The unpublished Crop Returns to the Board of Agriculture in 1801 show an almost perfect balance between arable and grassland in parishes such as Hanwell and Ealing.

The combined area of the four agricultural zones surrounding the capital was computed by Hunter as 240 square miles, which is almost exactly the area covered by Milne's map.

Thus London presented in the early nineteenth century a central place around which were developed distinctive patterns of land use. This was because it represented a sizeable market for agricultural produce. Communications were not good, with the result that carrying foodstuff more than a mile or two took a considerable time and, of course, certain types of produce were highly perishable. These considerations were enough to ensure that if the inhabitants were going to enjoy fresh milk, fruit and vegetables, they would have to be produced as close to the city as possible. But at the same time transport in the city depended on horses and these needed hay, a commodity too bulky to carry far. The horses and the stall-fed cattle gave a good supply of manure, but this too was not valuable enough to be carted far. Grain, which was valuable in relation to its bulk, not particularly perishable and could withstand the cost of

transport over a fair distance, appeared only on lands away from the immediate vicinity of the city. Livestock could be produced at an even greater distance and were, in fact, walked to market from as far afield as Wales and the Pennines. Their loss of condition was more often than not restored by a brief period of grazing on pastures in the Home Counties. It is also worth noting that the supply zones tended to extend further along the Thames estuary because of their comparatively easy access by sea. Thus we find a combination of circumstances in the early nineteenth century giving rise to an essentially von Thünen pattern of land use.

5 CONTEMPORARY EXAMPLES OF LAND USE ZONING AROUND CITIES

Land use zoning of the kind described by von Thünen does however appear in the modern context as is made clear in the *Reader* (p. 315). But it also implies that in the contemporary situation the question of scale is important, and that we should by and large look for zoning not so much around single urban centres, but around urban clusters at a national or even supra-national level. Nevertheless, there are exceptions. H. H. Stamer (1952) for example, has analysed the distribution of agricultural activities around the city of Hamburg in north Germany, which he considered to be the chief centre of consumption for locally grown foodstuffs. With the aid of data collected in 1950 from each of the *Gemeindes* (the smallest administrative units for which material is available) he plotted distributions by units of ten hectares, and showed that an irregular concentric zoning of land can be identified around the city. The fundamental factor causing this pattern was, he said, distance from the central city, with some modifications to the ideal pattern arising from conditions of the physical environment; in particular, soil conditions. In the zone closest to Hamburg he identified allotments. In the second zone commercial horticulture predominated with fruit

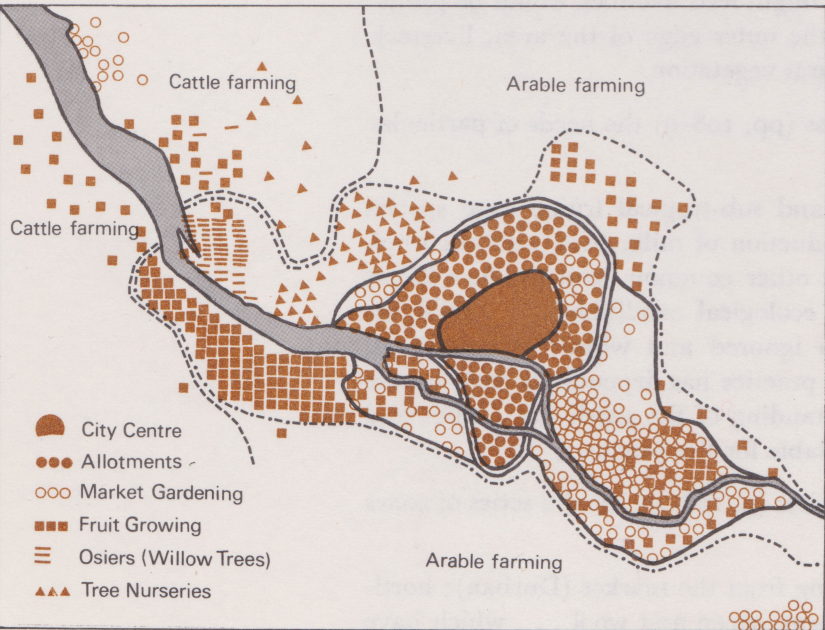


Figure 19.6 Agricultural land use zones around Hamburg, 1950.

growing, osiers and nurseries, each taking some account of the soil conditions. His outer zone was devoted to arable farming and cattle farming. The former tended to predominate in the east on the best drained land whilst the latter was found more on the western lowlands.

Another concentric zoning system about a predominant urban centre is to be found in Natal. There N. Hurwitz, in a study dating from 1957, has identified this phenomenon around Durban, or more particularly around the Durban-Pietermaritzburg axis. In the summary of his work on agriculture in Natal he has written (p. 106) this comment:

A striking feature of this study has been the development of the major production zones in conformity with land use theory. Land use can be explained by the principle of comparative advantage which, put simply, means that each area tends to produce those commodities for which its conditions are most favourable. Economic, social, physical and biological factors, all help to determine the comparative advantage of any area in the production of crops and livestock.

Later on, however, Hurwitz stresses the importance of economic considerations by citing the work of von Thünen (pp. 107-8):

He (von Thünen) shows that given suitable soil and climatic conditions, concentric zones of production determined by distance and transport facilities would surround a market. The zone nearest the market would concentrate on bulky perishable products possessing low value such as fruit and vegetables. In the second zone, less perishable and less bulky products such as potatoes would be produced. Milk which is perishable but less bulky, than such products as cereals and wheat, would also be produced. In a third zone less perishable products of high value would be produced (for example, butter, poultry and eggs). In the fourth zone, some distance from the market, the production of crops such as grain which might feed livestock would be profitable. In the fifth zone, on the outer edge of the area, livestock would be reared on the natural vegetation.

Hurwitz then goes on to discuss (pp. 108-9) the needs of particular agricultural commodities:

Wattles, sugar, tea, citrus and sub-tropical fruits, have special requirements. . . . The production of milk, beef, mutton, wool, maize, wheat, potatoes and other common farm produce is not so stringently regulated by ecological conditions. . . . In short, natural controls have been ignored and within certain broad limits the system of farming practice has depended largely on the predilection and financial standing of the particular farmer and the markets and prices available for the products.

In other words Hurwitz recognises (p. 108) in Natal a series of zones of production:

in the following order starting from the market (Durban); horticulture, dairying, cereals, meat, sheep and wool . . . which have arisen primarily as a result of prices and costs and their order and width depend on the perishability, value to weight ratio and the conversion factor, that is the amount of feed required to produce a given weight of animal product.

This is very much the von Thünen landscape and although Hurwitz deals with it in some detail we need only observe by way of reinforcement some of its more significant aspects. The production of market garden vegetables is for example at its most intensive in a zone some ten to fifteen miles deep extending from the borders of Durban to Pinetown. The innermost parts of the dairying zone – those areas closest to Durban and to Pietermaritzburg – tend to be the suppliers of fresh milk, but it is interesting in terms of the von Thünen concept to note the extension of the zone of fresh milk supply along the main railway route from the main markets as far as Estcourt in the north-west. Finally, Zululand, the most distant area of Natal in terms of access to the main population centre, is as one would expect, given over to low density cattle ranching (Hurwitz, pp. 81, 90, 91).

6 EXAMPLES OF LAND USE ZONES AROUND SMALL TOWNS AND VILLAGES

Below the level of the large urban centre, contemporary examples of zoning can also be found. Here the concentric areas develop around the central village or small town primarily as a response to the distance travelled by farm workers from their homes and the needs, in terms of intensity of cultivation, of the crops grown. The parallels with von Thünen's discussion of the internal land use organisation of the farm described on page 13 are now obviously at their closest. Examples of this phenomenon can be identified in areas of the Mediterranean characterised by the highly nucleated settlements of southern Italy, Sardinia and Sicily. Some of these settlements can be as large as 10,000 persons with the farm workers travelling out each day to the fields. Of the situation in Sicily, N. Prestianni (1947, pp. 98–9) writes:

The large settlements, where practically all the peasants live, are generally situated on hilltops or hill slopes sometimes dominated by a ruined castle. Around these settlements there is a zone of intensive tree and herbaceous crop cultivation, small fruit and vegetable plots, forming a halo of greater or lesser extent according



Figure 19.7 Typical hill-top village in Sardinia.

to the size of the village. Beyond this zone extend the former fiefs or latifundia, generally devoted to cereals and pasture. Interestingly cultivation is most intensive immediately adjacent to the village (on the hill sides) where the land is of poor quality.

The zone of intensive cultivation is composed of small or minute properties which are fragmented and dispersed and mostly derive from leasehold concessions. They belong to all classes of the population – the wealthy, professional persons, wage workers, artisans and peasants.

M. le Lannou (1941, p. 188) has written about a similar situation in Sardinia:

From whichever side one leaves a village, one is struck by the rigorous disposition of the various elements of the countryside into concentric zones. Around the village . . . there is a first zone in which the view is restricted, where the parcels of land are small and bounded by hedges of prickly pear, growing vegetables, olives, almonds and vines. But this pleasant labyrinth constitutes only a narrow belt, and suddenly there opens out a landscape which is flat and bare, without walls, without hedges, without trees: these are the arable lands. . . . Completely cultivated in the area nearest the village, this territory becomes poorer in the distance, and the amount of fallow increases. . . .

The landscape deteriorates not because of poorer natural conditions but because of the distance factor. The amount of fallow rises as the distance from the village increases, indicating the falling intensity with which grain is cultivated.

A well documented example of zoning around a larger settlement in the Mediterranean area is to be found at Canicatti. This settlement of about 30,000 inhabitants is 18 kilometres away from the nearest place of similar size and is typical of the larger agricultural centres in this part of Sicily. Michael Chisholm (1965) has written of it and draws attention first to the following table (p. 63):

TABLE 1
CANICATTI, SICILY: PERCENTAGE OF LAND AREA IN VARIOUS USES AND LABOUR REQUIREMENTS PER HECTARE IN MAN-DAYS

Distance in kms. from Cani- catti	Percentage of land area										Average number of man- days per hectare in each distance zone
	Urban	Irrig- ated arable and vege- tables	Citrus fruits	Vines	Arable- with- trees	Olive	Trees*	Arable unirri- gated	Pasture and pro- ductive waste†	Coppice wood	
0-1	44.7	—	—	15.8	—	—	19.7	19.7	—	—	52
1-2	—	—	—	18.0	16.7	8.4	41.0	15.9	—	—	50
2-3	—	—	2.6	2.3	21.8	14.4	35.4	23.6	—	—	46
3-4	—	—	2.1	13.3	18.7	0.6	47.2	18.1	—	—	50
4-5	—	—	—	5.1	19.2	2.4	28.4	43.4	1.4	—	42
5-6	—	1.0	—	6.3	4.7	1.6	17.6	64.1	4.7	—	41
6-7	1.3	0.7	—	3.3	6.7	—	18.3	68.7	0.9	—	40
7-8	—	—	—	4.0	7.7	—	23.6	62.4	0.8	1.6	39
Total	1.0	0.3	0.4	6.1	11.1	2.2	26.3	50.8	1.4	0.4	—
Average number of man-days per hectare ..		300	150	90	50	45	40	35	5	5	42

* Mainly almond, hazel, carob and pistachio. † Sometimes sown.

The above table has been compiled from the relevant sheet of the Land Use map (scale 1:200,000) and from information supplied by the Istituto Nazionale di Economia Agraria in Rome regarding the annual labour requirements per hectare of particular crops. The distance zones have been taken from the centre of the settlement. The average labour requirement in each distance zone has been obtained from the data for the crops and the relative importance of each in the various zones. The location of the small amount of irrigated and citrus lands is determined by the very limited area which is suitable.

Apart from the two categories just mentioned, it is interesting to note that the land use pattern conforms to the descriptions which are quoted above. But as Chisholm points out (pp. 62, 64), there is:

a particularly marked diminution in the importance of vines, olives and arable-with-trees as the distance from the centre increases; the relative decline of the other tree crops is less marked. In this particular case, 4 kilometres is the critical distance, beyond which open arable land (growing mostly wheat and barley) becomes predominant. Also evident is the decline in the amount of labour applied to each hectare as the distance increases, with again a sharp change at about 4 kilometres. The actual diminution of labour input is undoubtedly much greater than is indicated for two closely related reasons. First, it has been assumed that the actual labour input remains the same for each crop irrespective of the distance from the centre, an assumption which is evidently not reliable, as we have previously seen. But the data with which to allow for this are not available. Second, the arable land tends to be left in fallow more frequently at greater distances and when so left requires very little attention. Thus the right-hand column of the table should be interpreted in the following manner: it indicates the minimum rate of reduction of labour units with increasing distance, and measures the magnitude of the labour economy which is actually achieved solely by the substitution of less demanding crops towards the periphery of the commune's territory, taking no account of the variations in the intensity with which individual crops are grown.

The phenomena described by Chisholm above are paralleled in Spain. P. Birot and J. Dresch (1953) have noted in the arid Mancha district, south of Madrid, that (p. 218):

On an almost perfectly homogenous soil, the pattern of land settlement and use is remarkably geometric. In the middle of the bare plain, very large villages rise up. Sometimes one sees only four or five of them in the space of 600 square kilometres. The fields are, bare in one part, with olive groves or vineyards in another, arranged in concentric circles around the villages. The latter crops (olives and vines), cover an important area, and are not usually found closer to the village than 3 or 4 kilometres. There is a third and outer ring; the uncleared land abutting on the surrounding uncultivated hills. In some, there has been an annual clearance about the first centre, devoted sometimes to the extension of grain growing, sometimes to that of bush cultivation according to the needs of the population and the state of market demand.

The inversion which results in the arable land being closest to the settlement is interesting. One research worker, (Pons, 1956, pp.

190-1), has explained this by saying that under the particularly severe climatic conditions of central Spain the cereals need more applications of labour than the vines and olives.

Outside the Mediterranean area examples of zoning around villages or small towns are to be found in other areas of Europe. In Bulgaria, Birot and Dresch (1953, p. 83) observed, before the communist take-over, that this situation was fairly general. Farms were grouped into villages each adjacent to land set aside for growing vegetables, fruit, a few vines and cotton. Close to the settlement were common pasture and woodland. A small wood and an area of communal pasture are always situated close to the village. A little farther away came the specialised cultivations which required a lot of work: vineyards, rose fields and tobacco fields. Finally, the whole of the arable fields gave way to the biennial rotation. Winter cereals alternated with summer crops like maize, sunflower and beetroot for forage. Finally, at the edge of the land, towards the forest, one sometimes found pioneering vineyards and pungent rose fields. This arrangement of a concentric whole recalls that of New Castille.

Other examples of zoning around villages which are primarily distance-related can be found in India and Africa. R. M. Prothero (1957, pp. 72-86) noted an example in northern Nigeria, at Soba, which is one of many villages where four important categories of land use can be seen. (See map, Figure 19.8.) Inside the village walls, the houses are mixed in with 'gardens' where vegetables, herbs and so on are grown with much interplanting and 'catch' cropping.¹ These gardens are frequently visited and receive enough manure to keep them going continuously. Outside the walls continuously cropped land extends to over a kilometre and is fertilised by manure from cattle which are kept penned in the area. This zone grows Guinea

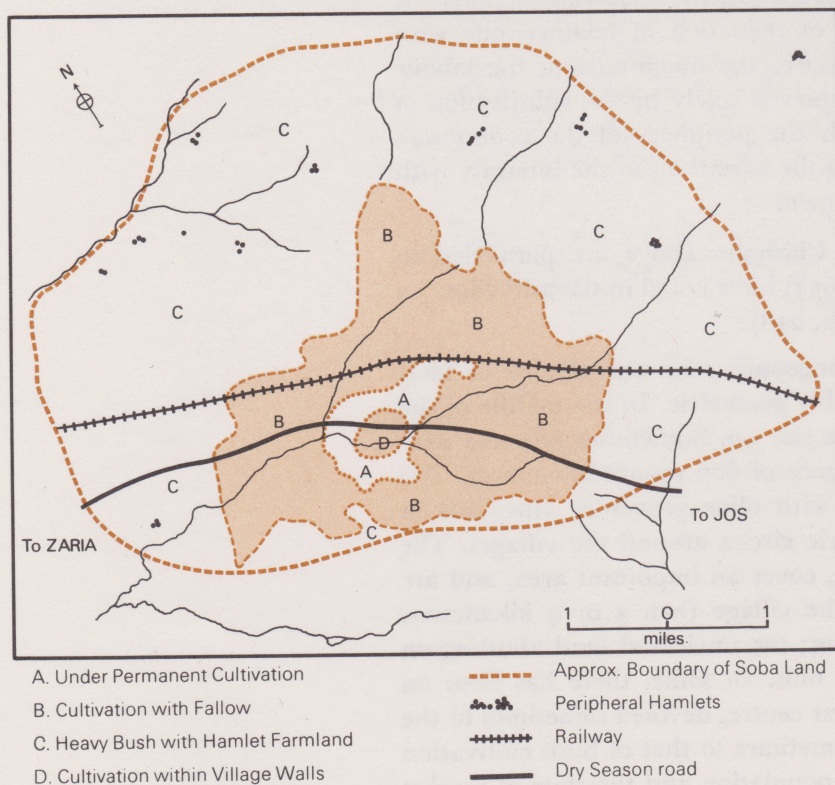


Figure 19.8 Land use zones at Soba, Zaria Province, Northern Nigeria, 1957.

1 A catch crop is grown in the period between the harvesting of one main crop and the sowing of the next on the same field.

corn, cotton, tobacco and groundnuts. The next zone, which varies from under one kilometre to over one and a half kilometres in width, is under rotation with 3 to 4 years cultivation and a minimum of five years fallow during which time it reverts to bush so as to restore fertility. Beyond extends the zone of heavy bush in which other villages exist with the same land use zones around each. It is clear from Prothero's account, that though terrain modifies the zoning around Soba, it is mainly a result of the problems posed by distance.

7 A SPECIAL CASE OF SMALL SCALE LAND USE ZONING

A contemporary example of the same argument at a similar scale but in a highly developed country is to be found in the canning and freezing industries in the U.K. Certain crops such as peas, green beans, soft fruits etc., once to be found growing in market gardens in close proximity to urban centres, are increasingly becoming field crops and grown in areas suited to large scale mechanical harvesting. When the crops are ready for picking, there is a need to harvest them rapidly and to get them to the processing plant with the minimum of delay, whilst they are still in first class condition. The result has been the creation of new market zones of 10 to 12 miles radius around the processing factories, particularly in the eastern counties such as Lincolnshire.

8 LAND USE ZONING IN RELATION TO A SINGLE COMMODITY

As a rule, however, the impact of modern technology in terms of food processing and transportation has been to enlarge the zoning concept beyond the level of the village and the town, particularly when viewed in relation to rapid urban expansion in the twentieth century. Today we can look at agricultural land use zoning not so much in terms of its development around a single urban community or communities (where, by and large, it may be more representative of a less developed form of society), but more in terms of its development around an urban industrial nucleus which may even be of a supra-national order. Certainly if we take one example, milk, we can use it to show how its zone of production has expanded through the impact of technology and the demands of an urban society. In the Rev. Henry Hunter's time milk had to be produced close to population centres like London because of its perishability. The coming of the railways in the 1830s, the later development of road transport, refrigeration and sterilisation techniques has increased the distance it could be carried safely, from a few miles to many hundreds of miles. This made possible the great enlargement of the areas supplying urban centres. That such an enlargement took place in the United Kingdom is due to three principal factors. First, not only had urban populations grown but their living standards had also risen. Secondly, better transport and the United Kingdom's ability to import wheat and meat from more distant parts, led more farmers into the milk business. (Indeed, today, some 25 per cent of the gross income on U.K. farms comes from milk.) Thirdly, most of the United Kingdom lay within the supply areas of the major urban concentrations. Today certainly the whole of the country is in the zone of milk production. However, as far as the remote areas are concerned, it is

only since the 1930s that the production of milk for sale has become substantial. For example, Anglesey, off the north-west coast of Wales, was very much peripheral to the country as a whole, let alone the main market centres. Thus up to the early 1930s it was essentially a stock-rearing area. But in 1934 the Milk Marketing Board established a creamery at Bangor which encouraged the production of milk by virtue of its capacity to manufacture it into milk products. Then in 1944, a liquid milk depot was also opened on the mainland adjacent to Anglesey and the milk now collected, treated and bottled at this plant is consumed locally and in Liverpool (Barnes, 1955, pp. 137-155).

Not only has the Milk Marketing Board since its inception encouraged the production of milk through the provision of better processing facilities, particularly in the remoter areas, but it has also encouraged the wider development of zones of milk supply by its pricing policy to the producer, as we noted in the *Reader* (p. 297). Clearly this policy must favour producers in areas remote from the market. It is there that the largest percentage increases in production can be noted. Parts of the west of England, once traditional butter and cheese makers, are now primarily suppliers of liquid milk to the main population centres, whilst areas like the extreme north, upland Wales and Cornwall, where formerly there was little or no milk for retailing, have in more recent years experienced a rapid increase in milk production for manufacturing.

Clearly then the zone of liquid milk production, at one time located around towns and cities, has spread out to include most of lowland Britain, pushing milk for manufacturing farther towards the periphery of the country, away from the urban centres. This has taken place as a result of improvements in technology and transportation, together with policy decisions by the Milk Marketing Board. The supply zone for the urban milk market does not extend beyond the United Kingdom. Perishability and the value of the commodity in relation to its bulk are factors which prevent this in spite of the fact that continental producers receive a lower price for it than British farmers. Even milk in condensed form, where it has lost two-thirds of its bulk, is hardly ever imported. Indeed only when milk is reduced to between ten and fifteen per cent of its original volume do imports become important. They then arrive in the United Kingdom as cream, cheese, butter and dried milk with their keeping qualities considerably enhanced by processing. However, imports of milk products in turn conform to a zonal scheme. This is made clear in Table 2, which we have taken from Chisholm (1965, p. 98).

It is noticeable that nearly all fresh cream comes from Zone 1, mainly Eire, and that the larger part of the preserved cream and condensed milk comes from the same Zone. On the other hand, butter, cheese and milk powder come from the most distant places. They represent the most processed commodities with the greatest weight loss and in the case of butter and cheese, it is even worth while to refrigerate them to bring them to this country. K. R. Clark (1966, p. 86) of the Institute for Research in Agricultural Economics at Oxford, has estimated the weight of butter obtained from one million litres of milk as 39 tons; cream 82 tons; cheese 99 tons; dried milk (full cream) 124 tons; and condensed milk (full cream) 372 tons. Remembering that cream is perishable, these figures are entirely consistent with the patterns of imports described above.

All the same, as you may realise, there is a product differentiation

TABLE 2

Commodity	Imports as % of gross Supplies	Zone 1	Zone 2	Zone 3	Zone 4	Other Countries
Cream, fresh	11.3	98.2	—	—	—	1.8
Cream, preserved	14.2	97.1	—	—	—	2.8
Milk preserved not dried	1.5	84.8	—	—	—	15.2
Cheese, blue-veined	—	83.4	14.9	—	—	1.8
Butter	90.6	30.0	5.4	—	64.2	0.3
Milk Powder	45.7	17.0	—	—	81.7	1.3
Cheese, other	54.5*	12.6	1.8	3.7	80.5	1.5

* All imports as percentage of all home production of all cheese types.

Zone 1. Belgium, Channel Islands, Denmark, Eire, Netherlands, Norway.

Zone 2. Austria, Finland, France, Italy, Poland, Spain, Sweden, Switzerland, Yugoslavia.

Zone 3. Algeria, Canada, Canary Islands, Cyprus, Egypt, Lebanon, Libya, Malta, United States.

Zone 4. Argentina, Australia, British East Africa, Chile, New Zealand, South Africa.

Sources: Official production and trade returns, with some supplementation from unofficial sources.

to be noted between Danish and New Zealand butter. Danish butter looks and tastes different and is only lightly salted, if at all. On the other hand, New Zealand manufacturers have to take measures to preserve their product which accounts for its saltier taste and its darker appearance. A similar situation is to be found with cheese imports. We rely on the Continent for our imports of soft, short-life cheeses such as Camembert and Brie, whereas cheeses from New Zealand are of the Cheddar type with excellent keeping qualities.

So we can see that the production of milk and milk products bears a zonal logic well founded in original agricultural location theory but modified in the light of new transport techniques and other technological developments, and that one of the most noteworthy aspects of this situation is the expansion of production zones beyond the immediate vicinity of isolated urban centres in the United Kingdom.

9 LAND USE ZONING AROUND URBAN AGGLOMERATIONS

The expansion of agricultural production zones in the twentieth century centred not on single urban nodes but on urban agglomerations which disregard national frontiers, is a concept which many writers well versed in the basic von Thünen theory have embraced. As early as 1925 O. Jonasson had expounded such a notion. After detailing some of von Thünen's basic theories he went on to say that:

north west Europe may be regarded as one vast conurbation and considered as one geographic centre of consumption and market facilities for the agricultural production of the entire inner belt of horticulture, olericulture, dairying and other intensive land uses (Jonasson, 1925, p. 291).

In elucidating this statement he has written

as a general thing animal products – milk, eggs, fresh meat – will

not stand transportation great distances and this fact associated with the relatively low economic per unit cost of production of vegetable foods as compared with animal foods had led to the concentration of dairy production upon the arable lands of the industrial section. . . . Since dairying and associated types of farming are the most intensive and these types are most profitable in and about the industrial communities, it follows that the whole system of land utilisation is centred upon them. In Denmark immediately contiguous to, and even part of, the industrial region, the growing of wheat, normally the most profitable of small grains, has given way to two-row barley and oats which here fit in more closely with the dairy type of agriculture that yields greater profit per unit area of land and per unit area of human effort than crop raising. In Argentina, by way of contrast, where industry is under-developed and land value is generally low, extensive agriculture is more profitable and wheat and corn are grown, not only because the climate and soil are favourable, but because the surplus can readily be transported and sold in world markets.

Jonasson concludes (pp. 291-2) that:

the general effect of this industrialism on the agriculture of north-west Europe has been to decrease the proportion of land devoted to the growth of small grains, with the exception of two-row barley and oats; to increase the acreage of pasture and fallow and to devote the land to the production of (1) forage crops for daily use such as hay grasses, clover, alfalfa, vetch and other legumes; (2) root crops yielding high returns upon correspondingly high expenditure of capital in equipment and fertiliser and of labour in tillage and harvest, such as potatoes, sugar beets, turnips, stock beets and similar crops, and (3) truck farming producing crops such as beans, peas, onions, lettuce, tomatoes and other garden vegetables.

Despite the inevitable agricultural changes that have taken place in forty-five years, much of what Jonasson says remains broadly correct. Indeed his remarks were supported by a map which S. Van Valkenburg and C. C. Held prepared in 1952 showing that the average yield of wheat, rye, barley, oats, corn, potatoes, sugar-beet and hay, declines with distance from the zone of farming of highest intensity centred on south east England, Holland, Belgium, north east France and Denmark.

The map reproduced below (Figure 19.9) indicates the incredible regularity of the zonal decline.

However, more recently other writers have argued in favour of the supra-national industrial nucleus as the centre of the zonal pattern of land uses. This lies at the heart of J. R. Peet's discussion published in 1969, and quoted in the *Reader* (p. 313) and indicates the contemporary relevance of land use location theory as first exemplified by von Thünen. Technological advance and urban expansion have been the major influences in changing to a substantial extent the scale at which we expect to find zonal land use patterns developing. This point was well made quite recently by J. T. Schlebecker whose words are summarised in the closing paragraph of Unit 19 in the *Reader* (p. 315), but it is further developed at greater length in Chapter 9 of Michael Chisholm's *Rural Settlement and Land Use* which should be read as the culmination of your rural

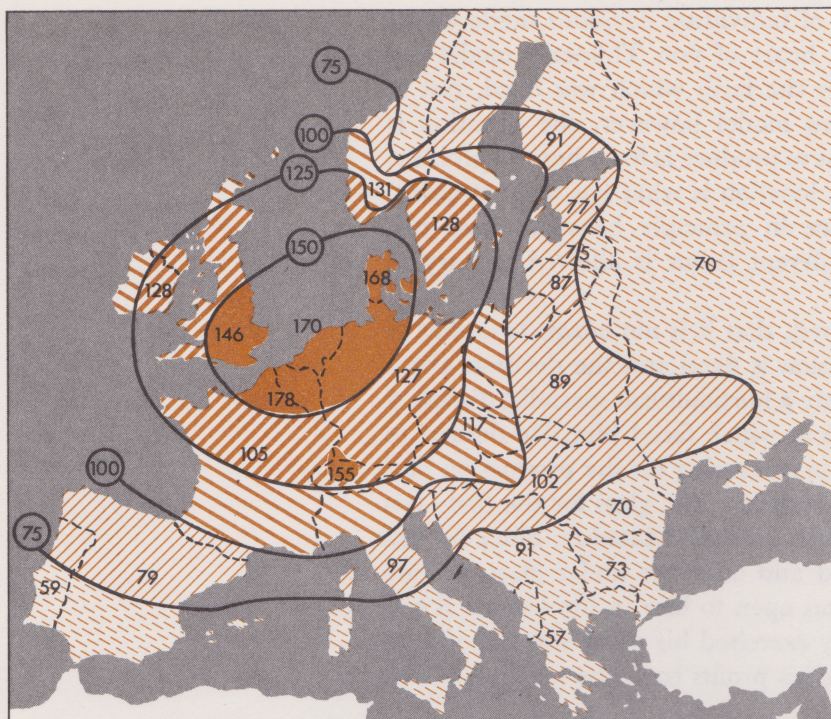


Figure 19.9 Intensity of agriculture in Europe. The index of 100 is the average European yield per acre of 8 main crops: wheat, rye, barley, oats, corn, potatoes, sugar-beet and hay.

land use studies. It should be remembered that the whole of the book is relevant to the discussion which has taken place in this unit.

10 THE VON THÜNEN MODEL AND A MODEL FOR INDUSTRIAL LOCATION

In the next unit we shall be using another type of model but this time its purpose will be to throw light on the basic processes which determine the location of industrial enterprises as opposed to agricultural land use patterns. But the fact that we will be using a model to help us once again in our understanding, is not the only connection between this and the next unit. Indeed one well known writer working in the field of location geography, W. Isard (1956, Chapter 1), recognised common ground in the von Thünen model and in the industrial location model we shall be considering, which was devised by Alfred Weber (1909). Isard pointed out that at the centre of von Thünen's work was the notion of a general pattern of land use based on the sum of many individual decisions about what to grow. On the other hand the approach utilised by Weber was, as we will see, mainly concerned with the problem of the location of one individual industrial enterprise. The common ground exists, as Isard pointed out, because of the tendency of certain types of industries to come together spatially; that is, to agglomerate. This phenomenon stems from the summation of many individual choices, concerning the best area in which to locate and the natural outcome of this is the formation of industrial zones or belts. It is at this point that the concepts of Weber and von Thünen coincide. At the same time, there is other common ground in the smaller scale of individual enterprise, which may be a farm or a manufacturing firm.

Von Thünen, as we have seen, was interested in discovering zones of common agricultural production, but his technique of analysis depended on the understanding of what happened at the level of individual holdings, with his zones representing, as we said

a moment ago, the summation of individual decisions made about cropping and stocking. At the heart of von Thünen's model lay the problem, not of location for the farm which was fixed, but of what to grow. In the Weberian model however, the situation is reversed – the decision as to what to produce is fixed but the problem of the best possible or optimum location is what has to be decided. There is therefore no difference in principle between these two concepts – it is only that a different factor is allowed to vary in each case.

Of course, it has to be admitted, that it is not *always* true that in the case of agriculture the location is fixed and the decision about what to grow is variable. Recently a horticultural specialist discussed with the present writer a problem which faced him. He desired to set up a new small enterprise concentrating on the production of a limited range of high-value vegetables under glass for the first-class hotel market centred on the south coast and London. Since he was able to purchase high-cost land and cultivate under glass, a wide range of location possibilities was open to him in the United Kingdom. The problem which really exercised his mind was the need to find a location at a point where his profits could be maximised and his outgoings minimised.

Exactly the same problem faces an industrialist opening up a new factory. Since he has to take into account the expense of assembling his raw materials, his production costs, and his distribution expenses, then the main differences between him and the horticulturalist mentioned above lie in the varying importance which each attaches to the different factors, and in the scale of their respective enterprises.

In reality, there is a complete range of agricultural production units from the type just described to that where the location is given and the decisions need to be made about the best of land use patterns. Indeed one of the points von Thünen made in his book *Der Isolierte Staat* was that his analysis provided a tool for determining the optimum location for any given type of agricultural enterprise, if all the appropriate information was to hand; though as we know his original model assumed a given production location.

Another similarity between the von Thünen and the Weberian models lies in the notion that in both it is assumed that a certain amount of information is known. To be exact, the location of the destination of the produce has to be known, along with the location of sources of inputs, whether they be raw materials or fertiliser, and the scale at which the particular enterprise is being worked. The precise implications of these factors with regard to the industrial location model are discussed in Unit 20.

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ILLUSTRATIONS

British Museum, Fig. 19.5; Camera Press, Fig. 19.7; Hutchinson & Co. Ltd., Fig. 19.2 in M. Chisholm, *Rural Settlement and Land Use*; Mansell Collection, Figs. 19.1 and 19.4; Paul Parey, Hamburg, Fig. 19.6; Clark University, Mass., Fig. 19.8 in *Economic Geography*, 1957, pp. 72-86; United States Department of Agriculture, Figs. 19.3a and 19.3b; in *Regional Variations in Prices Received by Farmers*, 1953; John Wiley & Sons, Fig. 19.9 in S. van Valkenburg and C. C. Held, *Europe*, 1952.

Unit 20

Location of Industry



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LOCATION OF INDUSTRY

1 A CASE FOR A THEORETICAL LOCATION MODEL

This unit uses a model conceived by Alfred Weber (1909), to explain some of the basic factors which govern the spatial pattern and location of industrial or manufacturing activities. Some of the model's characteristics must be apparent from the brief comparisons made between it and that of von Thünen at the end of Unit 19. Certainly it will have already crossed your mind that Weber conceived a device that will allow us to appreciate the relationship between industrial activity and other economic and social phenomena. This contrasts quite sharply with the situation which existed a generation ago when industrial geographers were mostly concerned with description and hardly ever with explanation. Indeed what explanation there was mainly attempted to establish a link between industrial activity and the physical environment. It could not be denied that for a long time no real need for a theoretical base, from which to undertake a study of industrial location, was recognised. Case studies of industries, or of industries as they related to regions, seemed to be of greater interest. The possibility of building a conceptual framework that would unify the many and varied threads of industrial activity, so as to allow its spatial pattern to be appreciated as a whole, was ignored. Wilfred Smith, writing in 1955, saw the need however and in introducing his paper 'The Location of Industry', which is quoted at length in the *Reader* (pp. 319-29), understood well that:

the economic geographer needs theoretical analysis to clarify his mind to define his problem and to strip it of the irrelevancies.

This is precisely why we have devoted the major part of this unit to the comprehension of a theoretical model, though as we shall see, the true gains for the industrial geographer come when theory and empirical research are joined. But to start with, let us deal as simply as possible with the theoretical aspects of industrial location theory.

2 THE BASIS OF LOCATION THEORY

Of first importance to the theoretical approach as used by industrial geographers is the notion of optimum location. This concept, that for every production unit there is a best possible location, is drawn from the writings of D. Ricardo (1817) whom we mentioned in relation to the von Thünen model, as well as Adam Smith (1776) and John Stuart Mill (1848). They assumed that conditions of perfect or near-perfect competition could exist. It was from such notions that location theories were developed which tried to balance the supply of factors of production and the demand for products inside an established areal pattern of production. In other words, they attempted to provide for a spatial equilibrium of activities. Naturally this 'balance' cannot exist since the price of a commodity, which is a function of supply and demand, cannot adjust itself adequately to a change in supply or demand before another change comes along.

All the same, the notion of the optimum or the best location, with the existence of spatial equilibrium, is useful, as it provides a yardstick against which to measure existing patterns.

It is from these basic ideas that location theory, which determines the best or optimum location by minimising transport costs, has developed. Deviations from the best location are explained in terms of the variations in costs apart from those of transport. Weber, who produced the original work on his model in 1909, was concerned with the way the choice of location could minimise costs. It is for this reason that his notion is sometimes called the 'least cost' or 'cost minimisation' theory. Thus the optimum location is the point at which transport costs per unit of product are lowest. In other words the optimum location is the point where the benefits of agglomeration, or of labour availability, or both, are enough to counter the disadvantages of not locating where transport costs are least. The fact that different industries will have different optimum locations follows from the fact that they will have differing types and volumes of inputs and outputs and therefore cost structures. This explanation of Weberian theory is dealt with at greater length and in more detail in the *Reader* (pp. 316-18).

3 CRITICISMS OF WEBER'S THEORY

Critical aspects of Weber's ideas are again discussed in the *Reader* (pp. 329-36). However, it should be pointed out here that a major objection to Weber's model has been its concern with supply and its notion that the market exists as a single point. Whilst it is reasonable to consider the pattern of inputs in analysing location determinants, it is unreasonable to underestimate the importance of markets as areas of varying demand strength. Contrast this with the great virtue of the theory which is its acceptance of the existence of transport as a factor, as well as such other factors as agglomeration, labour, and localised and ubiquitous materials for production.

For each factor a location cost is involved in bringing it to the production plant with the exception of the last named, ubiquitous materials, which by definition, have no location costs and cannot influence location. As you will see in your *Reader* (pp. 336-7), attempts have been made to improve the model. In 1940, Lösch (1954) for example, tried to incorporate demand into the model by considering closely the size of the market. He thought that the best location would be that which would command the largest market area and thus bring in the highest sales revenue. But in making the theory into one of 'profit maximisation', he tended to neglect supply almost to the extent that Weber had neglected demand.

In the 1950s, W. Isard (1956) and M. L. Greenhut (1956) tried to put right Lösch's omissions by considering costs more closely. They have suggested a model in which the optimum location is the point which combines the lowest possible costs with the greatest possible revenue. Isard, without success, tried to incorporate spatial variations in demand and supply in his plant location model. The working out of such an attempt must depend however on the application of advanced mathematical techniques which were not at his disposal at that time. Today these advanced techniques are available to us, but any fuller consideration of their application to spatial variations in demand and supply must await our second level course in geography.

Whatever improvements to the original model may be made, a fundamental relationship for the study of industrial location must be the difference between cost and price, for their variations define the limits within which production at a profit can be undertaken. Inside these limits the individual entrepreneur is free to locate where he will, though the size of his profits will vary according to the relevant cost-price relationship. In this connection D. M. Smith (1966) used the Weber model to construct his own theoretical device for undertaking geographical studies of industrial location. It presents the cost-price situation in an industry in a simplified way and is an immensely helpful aid in appreciating how a location decision is made (pp. 96-8):

In any industry, costs vary from place to place in accordance with variations in the cost of the necessary factors of production and in the cost of marketing. The total revenue obtainable also varies from place to place according to variations in demand and price. The most profitable location will clearly be where total revenue exceeds total costs by the greatest amount. The effect of spatial variations in cost and price are illustrated in Figure 20.1, which indicates the sort of conditions which exist, in a far more complicated form, in any industry in the real world. The spatial cost/price situations as shown here represent the simplest possible conditions, and are based on the assumption that cost and price are fixed and cannot be altered by the individual firm by, say large-scale production, changes of technique or factor combination, and entrepreneurial skill. For simplicity of presentation it is also assumed that output is constant in space, and that variations in demand, if they exist, are reflected in variations from place to place in price. Cost and price (£) are plotted on the y axis, and distance on the x axis.

The effect of variation in cost and price on location can best be seen by assuming one to be variable and the other constant. In Figure 20.1A costs are variable in space while demand is constant and the price obtainable (p) is the same everywhere. The average cost per unit of production at any point is indicated by the appropriate value on the line AC, which rises in both directions from point O. This line may be termed the 'space cost curve'.¹ O represents the point of minimum costs and Ma and Mb the points where the average cost is just equal to the price obtainable. The vertical distance between p and AC where price is above average cost (i.e., between Ma and Mb) indicates the average profit on each unit of production. As it is assumed that output does not vary from place to place, the spatial average cost/price situation indicated in Figure 20.1A also holds good for the total situation, with the appropriate adjustment of values on the y axis. Average cost thus becomes total cost (TC) and the price line shows total revenue (TR), all values having simply been multiplied by a constant representing total output. The vertical distance between AC (TC) and p (TR) where the revenue line

1 This is not to be confused with the cost curve of conventional economic theory which measures the change in cost as *output* changes. The 'space cost curve' assumes output to be constant and measures the change in cost as the *place* of production changes.

is above the cost line, now represents total profits, so O becomes the point of maximum profits, or the optimum location.

But Figure 20.1A shows more than simply the derivation of optimum location in a given cost/price situation. It also indicates limits to the area in which profitable operation is possible. These spatial limits, or margins, to profitability are indicated by Ma and Mb, which correspond with the points where $TC = TR$, i.e., where firms can just break even. Beyond the margin, where costs exceed revenue, firms can only operate at a loss, the size of the loss being indicated by the vertical distance between TC and TR.

Figure 20.1B represents the reverse of the situation illustrated in Figure 20.1A with costs assumed to be the same everywhere but with spatial variations in price. These price variations reflect variations in demand, p being highest where demand is greatest.

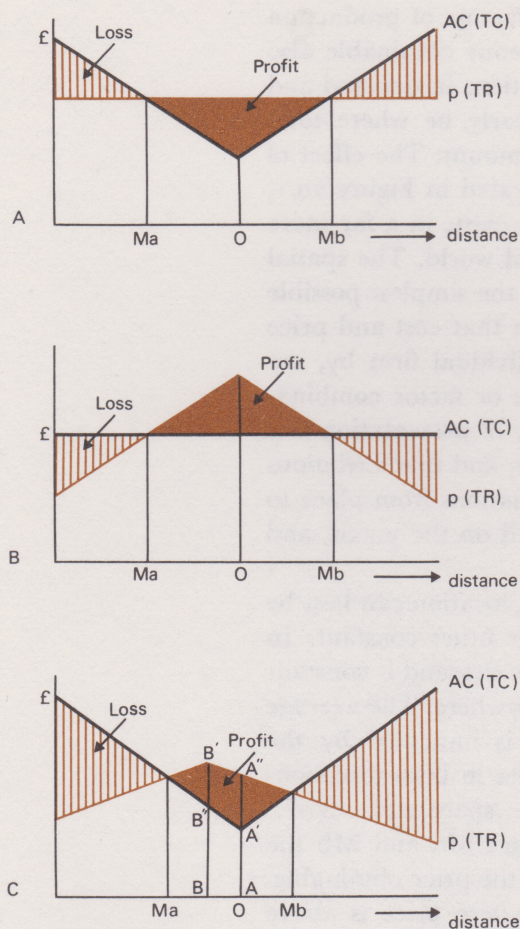


Figure 20.1 Optimum Location and Spatial Margins to Profitability in Different Cost Price Situations.

Again O is the location where average profit per unit of output is greatest, and Ma and Mb are the break-even points. As with Figure 20.1A this diagram can be taken to represent the total situation, as output is assumed constant and cannot respond to spatial variations in demand. AC thus becomes TC, and p becomes TR. O is now the point of maximum profits – the location at which TR exceeds TC by the greatest possible amount – and Ma and Mb represent the margin to profitability beyond which a loss would occur. This is, of course, only one possible way of representing a situation with spatial variation in demand; alternatively, price could have been held constant and output allowed to vary, with the possibility of economics of scale introduced. But the simple situation illustrated in Figure 20.1B is sufficient to show that

the concepts of optimum and marginal locations apply in just the same way as in a situation in which demand is constant.

In reality, of course, both cost and demand (as reflected in price in this simplified presentation) are likely to vary from place to place. This sort of situation is shown in Figure 20.1C, where the average cost rises away from point A, and where price is reduced away from B as demand falls off. Again the assumption of constant output enables TC to be substituted for AC or TR for p. An examination of the vertical distance between TR and TC now shows that the maximum profit point is A, where costs are lowest. Profit here ($A'-A''$) is greater than at the point of highest price, or greatest demand ($B'-B''$), and the manufacturer seeking maximum profits will therefore choose the least cost location despite the lower total revenue obtainable there. The reverse situation, with maximum profits at the high price (i.e., demand) location, could be illustrated simply by altering the gradients of the price and cost lines.

5 EMPIRICISM AND LOCATION THEORY

Apart from attempts like that of D. M. Smith's above to look at the basic theory of industrial location, most of the effort of industrial geographers has gone into empirical studies connected with quite specific industrial concerns, the aim being to gain more knowledge of the kind and strength of factors influencing location and location patterns. Perhaps many geographers have felt that the theoretical aspects of location were too removed from reality to warrant much effort in that direction. After all, even in D. M. Smith's model, assumptions are made that labour and material supplies are fixed and of limited supply, whilst Weber assumed demand and supply to be constant in space and that supply costs determined location. Certainly some of the most important attempts to test theory are the studies of Peter Haggett in his analysis of the zinc smelting industry and of Wilfred Smith, both of which are quoted at length in the *Reader* (pp. 318-19; 319-29). Wilfred Smith's study is the more significant of the two and represented a pioneering effort. He attempted to try to determine the relevance of Weber's notion, that those industries with a great loss of weight in manufacture would tend to be located close to their raw materials. He did so by applying it to the facts of location as they could be seen in selected United Kingdom industries. But since Wilfred Smith's paper only considered the weights of materials used in manufacture, it was only a start. It is unfortunate that he should have died before developing his research in other directions, particularly towards those concerns whose location is not in any way determined by materials. It is also sad that so few other workers have attempted to take up where Wilfred Smith left off.

One other attempt at testing location theory worthy of mention was made by C. D. Harris in 1954. In his paper *Market as a Factor in Localisation of Industry* (1954, pp. 315-48) he tried to consider the minimisation of transport costs along with population potential (which was a measure of the size of the market), in analysing location patterns. To Harris the question of the market rather than the source of materials, was however the key one. In looking at the United States of America situation he wrote (pp. 316-19):

Economic activities tied to the location of raw materials are

waning in relative importance; activities carried on near markets or in intermediate positions are surging upward. In contrast to falling employment in raw-material-oriented primary activities, employment in secondary and tertiary services is rising rapidly. Primary, secondary and tertiary as here used refer broadly to the production of raw materials, to the processing of materials, and to the performance of services, and not to basic or service function in the economic support of a given area. Between 1940 and 1950 the number of workers in agriculture in the United States diminished from 8.4 million to 7.1 million or about 15 per cent. During this same period employment in secondary activities grew from 13.5 to 18.6 million or 37 per cent and in tertiary activities from 22.3 to 29.3 million or 31 per cent. These shifts are part of a long-run trend. Between 1820 and 1950 the proportion of occupied persons in primary activities in the United States shrank from 72 to 13 per cent, while that in secondary activities expanded from 12 to 33 per cent, and in tertiary from 15 to 53 per cent. The location of the now dominant secondary and tertiary activities is not tied primarily to the distribution of raw materials, but exhibits a correspondence to the disposition of regional and national markets; yet these very markets are partly an outgrowth of the historical development of these self-same activities.

In the location of manufacturing as in economic activities in general, the distribution of raw materials is of decreasing weight. Materials undergo many processing stages from the crude raw material to the final product; in general the first stages are near the sources of raw materials, the intermediate stages somewhat footloose in location, and final stages close to the market. Products are becoming more highly fabricated with the result that the initial treatment of raw material is diminishing in relative importance; the automobile is more intricate than the buggy and the mechanical refrigerator than the ice box. Within related industries employment in the final processing segments typically is growing more rapidly than in early or intermediate stages. Between 1939 and 1947, for example, the rate of increase of production workers in the apparel industries (final stage) was nearly five times as high as in textiles, and in machinery nearly three times as high as in primary metals.

The production of iron and steel illustrates the decreasing significance of the location of raw materials in manufacturing. In the middle of the eighteenth century each ton of pig iron produced in Britain required about 8 tons of coal and 3 tons of iron ore. In the United States in 1952 for each ton of steel produced only 1.2 tons of iron ore, 0.9 tons of coal, and 0.6 tons of scrap were consumed. But about half the scrap comes from the market areas (the rest is produced within each plant). Excluding limestone, which is widely distributed, the ratio of the mined raw materials such as coal and iron ore to market-oriented materials such as purchased scrap and produced steel has sunk from 11 to 1 to a low of 1.6 to 1, or only a seventh as high. During this same period transportation and mechanised handling have become more efficient and much cheaper for bulky raw materials. Especially dramatic is the use of pipelines for the transmission of oil and natural gas. In general finished products do not lend themselves to bulk handling, but involve high labor costs in transportation. The truck, however, has benefitted short hauls of finished products.

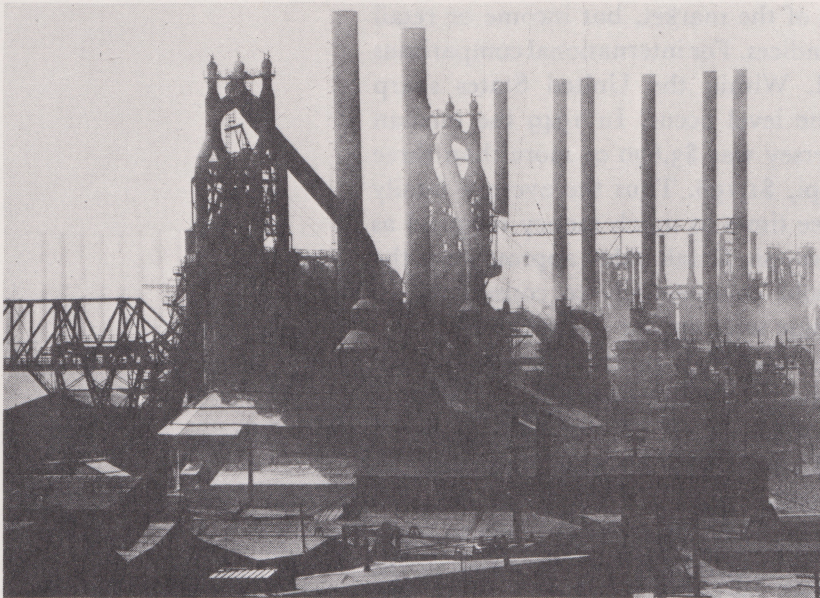


Figure 20.2 Steel making plant at Pittsburgh, Pennsylvania, U.S.A.

The production of iron and steel, even though a raw-material-processing industry, exhibits the importance of the market factor. At times the steel industry of Pittsburgh has been considered as 'based mostly on the coking coal of the Connellsville district'; it is equally an expression of superb central location amidst the huge markets of the American Manufacturing Belt.

Malcolm Keir demonstrated that the iron industry of Pittsburgh arose in relation to the market; iron-using factories, such as rolling mills and plow works, preceded by many decades the production of pig iron in the city. The conspicuous growth of the steel industry has been near markets, as symbolized by the founding of Gary near Chicago half a century ago and the recent construction of the Fairless Steel Works on the Delaware River convenient to New York City; both have low total transport costs by virtue of the cheapness of water carriage of distant ores and the proximity to markets. In spite of the favorable juxtaposition of local coking coal, iron ore, and limestone, Birmingham, Alabama, has remained a small producer. The small size of the Southern markets has been one factor stunting its growth. Duluth near the iron ore deposits of Minnesota has stagnated because of distance from markets. The general world distribution of the iron and steel industry exhibits a congruity with markets rather than with the distribution of coal, iron ore, or any other raw material.

Harris then went on (pp. 319–21) to deal with the question of the location of markets in the United States of America.

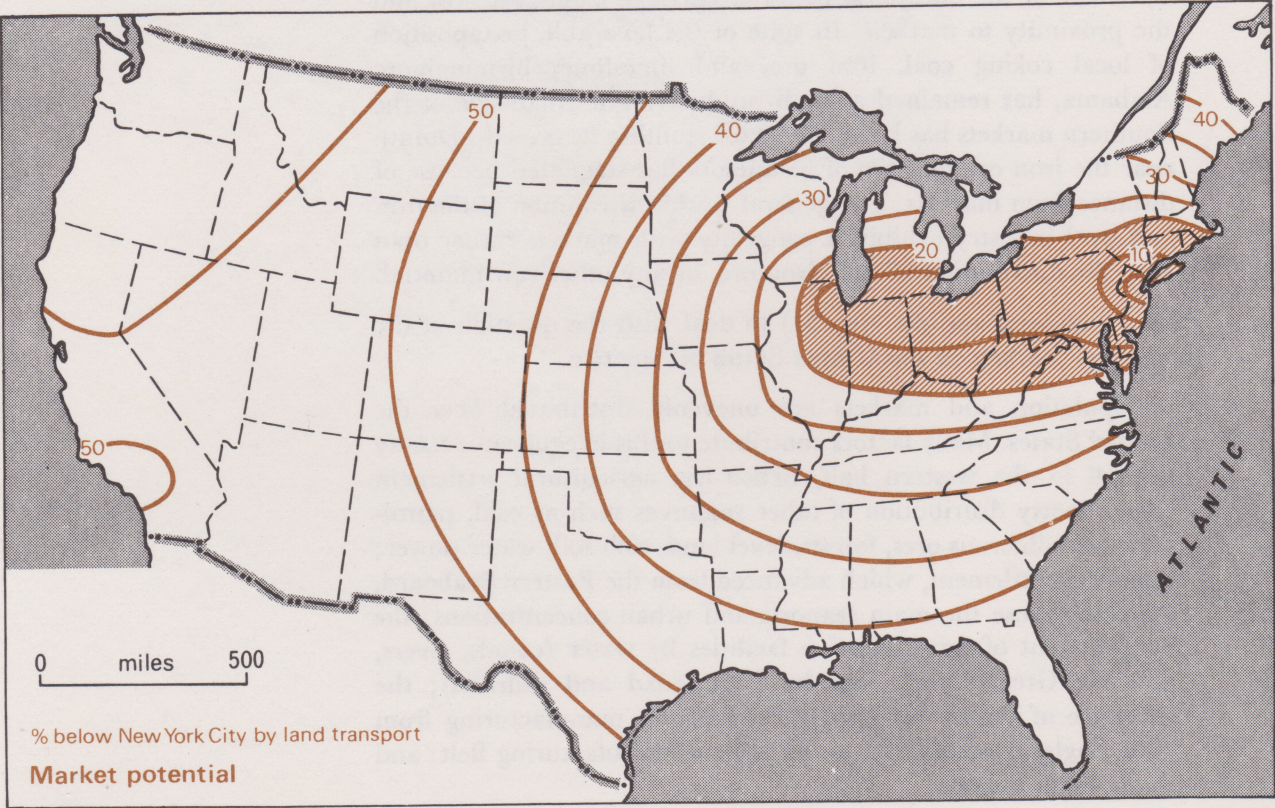
Population and markets are unevenly distributed over the United States. Many factors contribute to this irregularity: scanty rainfall in the western half, hence less agricultural settlement there; spotty distribution of other resources such as coal, petroleum, metalliferous ores, forests, level land, rich soil, water power; history of settlement, which advanced from the Eastern Seaboard, at which arose the main seaports and urban concentrations; the development of transportation facilities by water (canals, rivers, and the Great Lakes) and by land (road and railroad); the sequence of the rise and spread of modern manufacturing from New England westward into the present Manufacturing Belt; and many other factors.

Population is one measure of the market, but income or retail sales provide more adequate indices. For international comparisons national income serves well. Within the United States sharp regional differences in income level occur. In 1949 the median income per family in New Jersey was \$3,670 or more than three times as high as in Mississippi, \$1,198. Thus the average family in New Jersey has about three times as much money to spend as the average family in Mississippi. Retail sales approximate the ultimate market for goods sold commercially to consumers. In spite of certain limitations, these sales appear to provide the most valuable single index of the total final market for commercial goods. Fortunately such figures are readily available by counties from the Census of Business, 1948.

Half the retail sales in the United States are made in a small belt in the North-East, extending from Boston to St. Louis. A manufacturer distributing to a national market is likely to make about half his sales here. The development of industries in the South or the West has sometimes been considered evidence of a trend toward location near markets. Insofar as such developments represent branch plants to serve regional markets this interpretation is correct. Distribution costs from these areas to the total national market, however, run higher than in most parts of the Manufacturing Belt.

In terms of total size of market the North Eastern states dominate the entire country. On Figure 20.3 (b) the area of each state has been made to vary with the size of the retail market in the state. The country appears to be afflicted with a hospital case of hydrocephalus, in which the head (from Illinois to Massachusetts) has swelled six times the normal size to exceed in bulk the rest of the body. The shrivelled South East hangs limply like the forelegs of a kangaroo. The Mountain States have atrophied and nearly disappeared. The giant New York Metropolitan area is larger than

Figure 20.3 (a) Market as a factor in the localisation of industry in the U.S.A. (i) A market view.



all the Southern States on the Atlantic south of the Potomac. The Chicago Metropolitan Area takes the measure of Texas. Massachusetts equals the combined Mountain States.

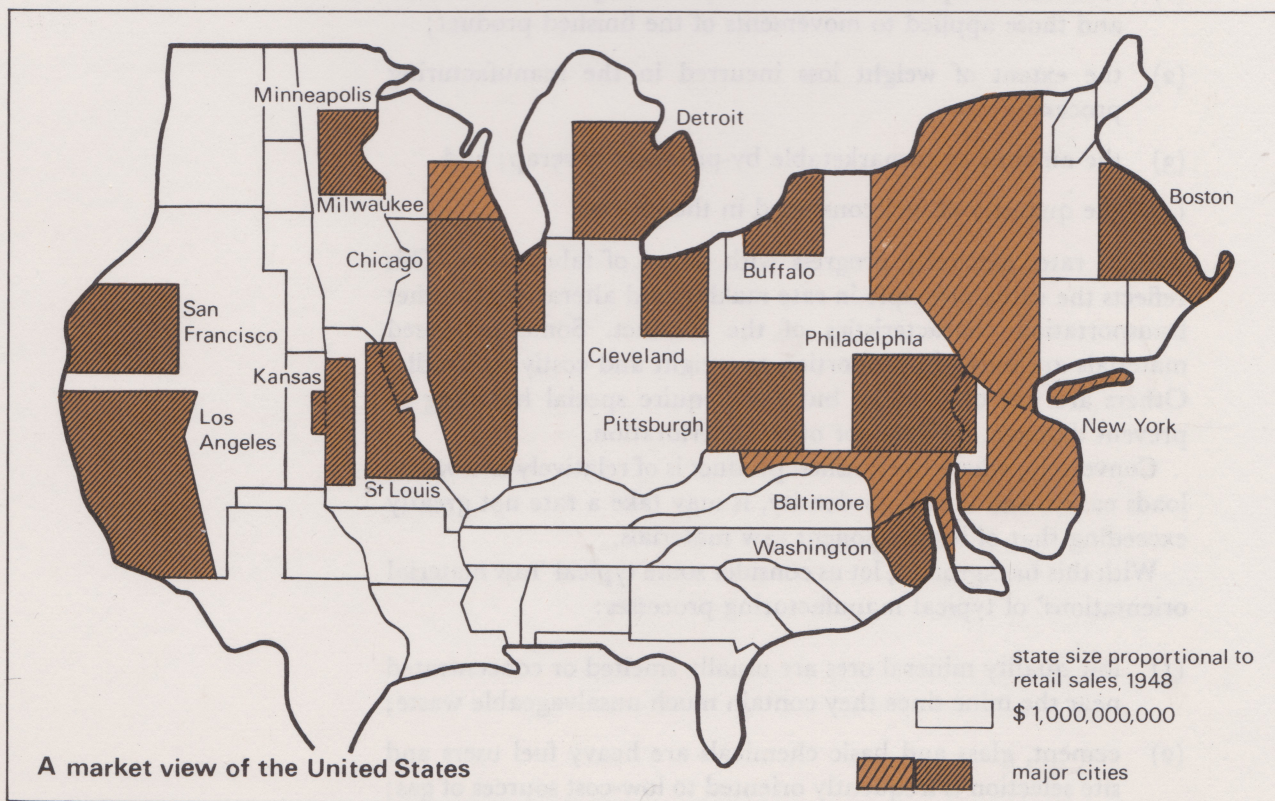
Some states in the North East have a density of market several hundred times as high as other states in the West. The United States may be divided into five grades of decreasing intensity of market as follows: (1) the Eastern Seaboard states extending from Massachusetts to Pennsylvania with very high densities, five to fifteen times the national average; (2) the western half of the Manufacturing Belt from Ohio to Illinois with densities several times the national average; (3) most of the rest of the eastern half of the United States with densities about the national average; (4) the central and southern Great Plains with low densities; and (5) the Mountain States and Dakotas with very low densities, only a twentieth to a fourth the national average.

Harris then attempted to determine more precisely in a quantitative way the relative accessibility of the various areas of the United States of America to the wide spread markets using his concept of market potential. This he expressed in the form of a simple mathematical equation which is quite easy to understand, with P representing the market potential.

$$P = \sum \frac{M}{d}$$

In the above expression P equals the sum of markets (Σ) accessible to a point (M) divided by their distances from that point (d). Distance was, of course, not expressed in terms of miles (as we would expect from our work in Unit 19) but in transport costs. Considering the market in national terms only, Harris demonstrated that the areal distribution of market potential shows the highest concentration in the manufacturing areas of the north east of the United States of America (see Figure 20.3 (b)) again reinforcing his earlier contention

Figure 20.3 (b) (ii) Market potential.



that the iron and steel industry of Pittsburgh may be looked upon as market-oriented at the expense of raw materials. The importance of the market is also dealt with in that section of the *Reader* dealing with reforms in the Weberian model (pp. 336-7).

6 STUDIES OF INDIVIDUAL INDUSTRIES

In sharp contrast to the paucity of studies which attempt to test location theory in relation to evidence from the real world, there are numerous case studies of either specific industries or of specific location factors. Their aim is to shed some light on how location factors work and how their influence varies between industries. Transport as a vital location factor has frequently been the subject of research. The article on freight rates in the *Reader* by Alexander (pp. 293-6) is taken from a broader study which examines the influence of transport pricing policies on industry at large (Alexander, 1958, pp. 1-18). Another research paper taking a broad look at the locationary influence of transport, with evidence gained in the United States of America, was written by M. Fulton and L. C. Hoch (1959, pp. 51-9). In any reading of their paper it has to be remembered that they are drawing on evidence from a federation of fifty states, very few of which are as small as the United Kingdom. This means that by our standards, references to local markets could cover very large areas indeed. However, this does not detract from their fundamental argument concerning transport and they state the case first of all for raw material orientation and market orientation in terms of what they call 'geographically necessitated' transport costs (pp. 55-6):

Whether an industry will locate close to raw materials or at some distance from these sources is largely a question of:

- (1) the relationship between the rates prevailing on raw materials and those applied to movements of the finished product;
- (2) the extent of weight loss incurred in the manufacturing process;
- (3) the amount of unmarketable by-products or scrap; and
- (4) the quantity of fuel consumed in the process.

Freight rates generally progress with stages of fabrication. This reflects the value principle in rate making and alterations in other transportation characteristics of the product. Some processed materials are bulky in proportion to weight and costly to handle. Others are not only bulky but also require special handling to prevent damage, spoilage, or other deterioration.

Conversely, where the finished product is of relatively low value, loads easily, and is of high density, it may take a rate not greatly exceeding that of its component raw materials.

With this background, let us consider some typical 'raw material orientations' of typical manufacturing processes:

- (1) low quality mineral ores are usually smelted or concentrated near the mine since they contain much unsalvageable waste;
- (2) cement, glass and basic chemicals are heavy fuel users and site selection is frequently oriented to low-cost sources of gas;

- (3) steel processing involves substantial weight loss. A source of cheap, high quality fuel is usually the greatest locational attraction rather than ore and fluxing limestone, since the input of coal is nearly a complete loss (cf. Harris who rightly argues the declining importance of fuel as a location factor);
- (4) agricultural processors locate close to the raw material producing areas due to waste consideration; e.g. beet sugar refining, cotton ginning, saw mills, etc.

Market Orientation

Improved transportation has greatly reduced the cost of moving materials to markets and has also increased the speed of distribution. Yet there are certain industries where the product is of sufficiently low unit value so that transfer costs are still a significant proportion of the delivered price. In these industries, location immediately adjacent to consuming markets is the governing locational factor.

Some of the industries which cannot successfully exist outside the immediate vicinity of local markets are bakery products, ice cream manufacture, artificial ice, bottling of milk, and job printing shops.

Other industries, carrying extraordinarily high freight rates as compared to the cost of assembling raw materials, must also locate near their markets. These manufacturing processes include tin cans, barrels and drums, and corrugated containers. Another group of products may be sold over a broader market area but the influence of nearby competitors and the size of the market govern location as well as the size of the production unit. These products include cement, brick, fertilizer, storm sash and prefabricated houses.

The authors then make the point that those responsible for the cartage of products have it within their power to initiate freight rate structures which can in turn exert significant influences on location (pp. 56-7):

They can, in some measure, perpetuate existing but badly located industries to the exclusion of similar plants in more favourable locations. Conversely, they may publish low commodity rates or extend special transit privileges which will foster new industrial developments.

No single policy has had a greater effect upon locational decisions than 'transit privileges'. Rates for short distances are commonly on a higher ton-mile basis than those for longer distances. Consequently, the combination of two or more local rates between two points is usually higher than the single through rate applying between the same two points on a given commodity.

The rate structure, therefore, would tend to foster the location of plants at either the raw material source or at the market rather than at the higher cost intermediate location. This situation can be completely reversed, however, by the granting of transit privileges.

The first transit privilege on record appears to have been offered in 1870 at Nashville, Tennessee. In 1909, the Wheeling and Lake Erie Railroad published rates granting the privilege of stopping steel in transit at Canton and Toledo for fabrication permitting the establishment of new fabricating plants in those

cities in direct competition with Pittsburgh producers.

We now accept the transit privilege as part of the normal transportation geography affecting locational decisions. The privilege has been extended to include the items shown in Table 1.

TABLE 1
COMMODITIES WITH TRANSIT PRIVILEGES

Commodity	Transit Privileges
Grain	Milling, inspection, mixing, grading, sacking and storage
Lumber	Manufacturing and further improvements
Marble and Granite	Finishing
Lead bullion and zinc ore.	Refining
Livestock	Grazing and fattening
Iron and Steel products	Fabrication
Cotton and Hay	Compression
Butter, eggs, dairy products, and dressed poultry .	Concentration
Miscellaneous manufactured products	Storage

The two writers finally consider a number of types of manufacturing where they believe that transport is a key locationary factor (pp. 57-8):

Steel

Semi-finished steel prices reflect a very large sum for transportation charges, including the cost of assembling raw materials and fuel as well as delivery cost from mill to customer. Raw material assembly costs may exceed 30 per cent of the total cost of manufacturing pig iron. Delivery of finished steel involves freight costs which average more than 10 per cent of its base price.

The steel industry is a heavy user of coal and has been more strongly influenced by the availability of fuel than any other single factor. Location near a high grade of coking coal available at low cost is essential to the large scale development of this industry. However, mills in the Gary-South Chicago District are an important exception. Although their assembly costs are somewhat above those of the Pittsburgh-Wheeling District, their nearness to western markets tends to counterbalance this disadvantage.

Whilst these writers, like Harris, accept the argument of strong market orientation for the Gary-South Chicago district, they still emphasise particularly the locationary strength of fuel for the Pittsburgh area, a point which we know Harris would want to qualify. But the two papers should not be considered as contradictory as far as steel is concerned. Market orientation for this industry is undoubtedly an important trend which in future is likely to become more pronounced, but it has to be remembered that Fulton and Hoch are concerned to emphasise the role of transportation which in the assembly of raw materials for steel is still of significance. Apart from steel, Fulton and Hoch go on to examine other types of manufacturing where transportation is an important factor:

Chemicals

The need for large supplies of coal or natural gas has influenced many chemical plants to locate close to the sources of these fuels. Proximity to coal, for example, has traditionally been an important factor in the location of plants manufacturing rayon. The concentration of petrochemical industries along the Gulf Coast reflects the delivery of cheap natural gas as well as the availability of water transportation.

Glass

Glass manufacture has been traditionally located close to supplies of natural gas because of its large fuel requirements. The proximity of glass sand deposits has been another important attraction.

Changing relationships between raw material assembly costs and delivery charges on glass containers have encouraged establishment of modern glass plants close to markets rather than glass sand deposits. This reflects, as well, the increased efficiency of long distance pipeline transportation of gas.

Cotton Textiles

The shift of cotton textile production from New England to the South is not explainable by savings in transportation costs of raw materials. While the South Eastern mills save 20 to 34 per cent on freight costs for cotton supplies compared to the New England mills, this saving represents only 0.3 to 0.7 per cent of total manufacturing costs.

Meat Packing

The spread between livestock rates and those applying to dressed meats is a matter of almost continual controversy before the Interstate Commerce Commission. Unquestionably, the growth of packing at centers west of Chicago and the resurgence of packing in the East, have significantly reduced Chicago's share of the total.

Flour Milling

The relationship between rates on grain and flour have had a significant effect on the location of flour milling activity. General freight rate increases have definitely caused a decline in production at Minneapolis and have contributed to the rapid rise of Buffalo as a flour milling center.

The milling-in-transit privilege has tended to equalize freight burdens, permitting the Eastern mills to compete with the Middle West. However, the wide application of the transit privilege is tending to eliminate the special advantages which have been obtained by a few milling locations, and cities in almost every geographic region are now competing for the milling trade.

Studies of individual locationary factors other than transport have been made in the field of labour where some interest has centred on a consideration of wages and the economies of scale both inside particular industries and outside them. Nonetheless, the weight of work has involved analysing the interplay of factors governing the location of specific industries. This began perhaps with E. M. Hoover's classic work dating from 1937 on the shoe and leather

industries of the United States of America, and ran through to R. C. Estall's sophisticated work of the mid-sixties on the electronics industry, where his concern was to relate its growth to a small clearly defined area of New England and to emphasise the ties between industrial production and research and development (Estall, 1963, pp. 189-216). Also of importance here has been the recent work of Gerald Manners (1969) who has taken a look at the location patterns of the iron and steel industry throughout the world. Quite often this kind of approach, though not quantitatively analytical in the true sense, can be valuable in allowing us to see a single or a whole range of factors at work. Two such studies are quoted in the *Reader* by F. E. I. Hamilton and J. R. Tarrant. Both of these examine the extent of governmental influence on industrial location. The former deals with the iron and steel industry in Yugoslavia and attempts an analysis of plant location in a controlled economy (pp. 330-2). The latter deals with the influence of government incentives on the process of industrial location, but in the free economy of Ireland (pp. 332-5). Notable collections of papers which analyse factors of location in empirical studies of specific industries have appeared in recent years from H. R. Jarrett (1969) and from R. C. Estall and R. O. Buchanan (1966). The work of these last named writers is listed as a set book and particular attention should be given to Chapters 9 and 10. It is here, that, as well as iron and steel and oil, they discuss at length the nature of location factors in the manufacture of motor vehicles, perhaps one of the most important industries in the western world because its prosperity is so intimately tied to the prosperity of whole nations. The classic remark made in the United States of America that 'what's good for General Motors is good for the country' is not an entirely flippant one, for the production of cars on a scale the community demands today must greatly involve the makers of iron and steel, non-ferrous metal products, machine tools, electrical products, bolts, nuts, paints, rubbers, plastics, and so on. Indeed, in the United Kingdom alone the motor industry purchases goods to the value of over two hundred million pounds a year from 24 out of a total of 38 industrial groups. Perhaps no further remarks are needed to justify the closer consideration of this industry and of the factors effecting its location, a task undertaken in the television programme associated with this unit.¹ Suffice to say here that an investigation of the United States of America and the United Kingdom vehicle production plants indicates that the following factors of location are important:

- (1) the economics of large scale production;
- (2) the need for access to supplies and to markets;
- (3) the part played by factors of production which include labour availability and attitudes, entrepreneurial perception and ability and government policies.

Thus it is apparent that some important considerations in this industry are not taken into account by the theoretical Weberian model even in its improved form. But it is unnecessary here to

1 This programme is based on research by R. C. Estall and R. O. Buchanan in *Industrial Activity and Economic Geography* (1966), pp. 194-210, and by myself.

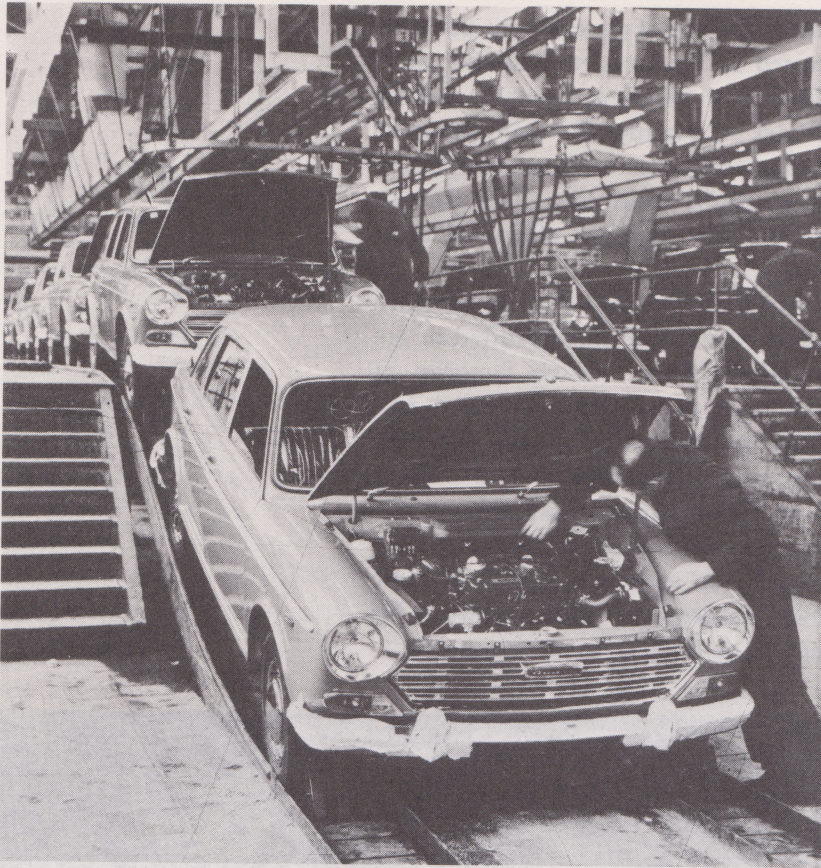


Figure 20.4 A production line at British Leyland Motor Corporation, Cowley, Oxford.

indulge in a full and detailed comparison between the model and this empirical study since the television programme and the associated notes cover the ground adequately. Nonetheless it is perhaps relevant here to stress at least one point that can be crucial in attempting to compare the model with contemporary examples of empirical studies of industries, and that is that location theory tends to concern itself with individual production units, whilst modern firms frequently consist of spatially separate but locationally interdependent units. One of the features of the car industry which we will deal with in the television programme concerns the way in which vehicle builders are taking component makers under their wings. To this we can also add that vehicle manufacturers today will have not only production units but also sales, research and administrative units. To think therefore, in the modern context of the single industrial unit in the way the location model does, is to understand only part of the story, since the industrial corporation is becoming ever more important in the economy. Contemporary industrial location patterns can only be properly understood therefore in terms which take account of the corporation. For spatial decision making is no longer the result of the testing of many individual decisions, but of very complex pre-arranged plans which are formulated by a body whose job is that of management and which remains separated from the owners, usually the shareholders. It may well be true as R. B. McNee (1960) has written that –

the separation of ownership from control destroys much of the commonsense value of the classical assumption of profit maximisation as the universal goal of business.

You will see that the television programme also draws close attention to the role of the behaviour of labour in the vehicle

building industry, as well as to the influence of government policies. The latter consideration is discussed in further detail in the radio programme. Neither of these factors of location, nor the role of management appear in the model. Certainly the behaviour of management in the formulation of policies must be important to the student of location. An example, again from the car industry, illustrates the point and shows the far reaching effects of such decisions.

A plant was established by Vauxhall at Ellesmere Port in Cheshire in the late 1960s. A single management decision then resulted in the transfer of several hundred employees from existing factories at Luton and Dunstable in the south-east to Ellesmere in the north-west. Further, it has to be realised that the value of the particular location for any one unit in the corporation depends, as McNee suggests (p. 203), not so much on the inherent advantages or disadvantages of that particular site, but the view the management has of its corporate position. The decision to open a new unit or close an old one may rest less on its own cost structure than on how it fits into the overall corporate strategy as envisaged by management.

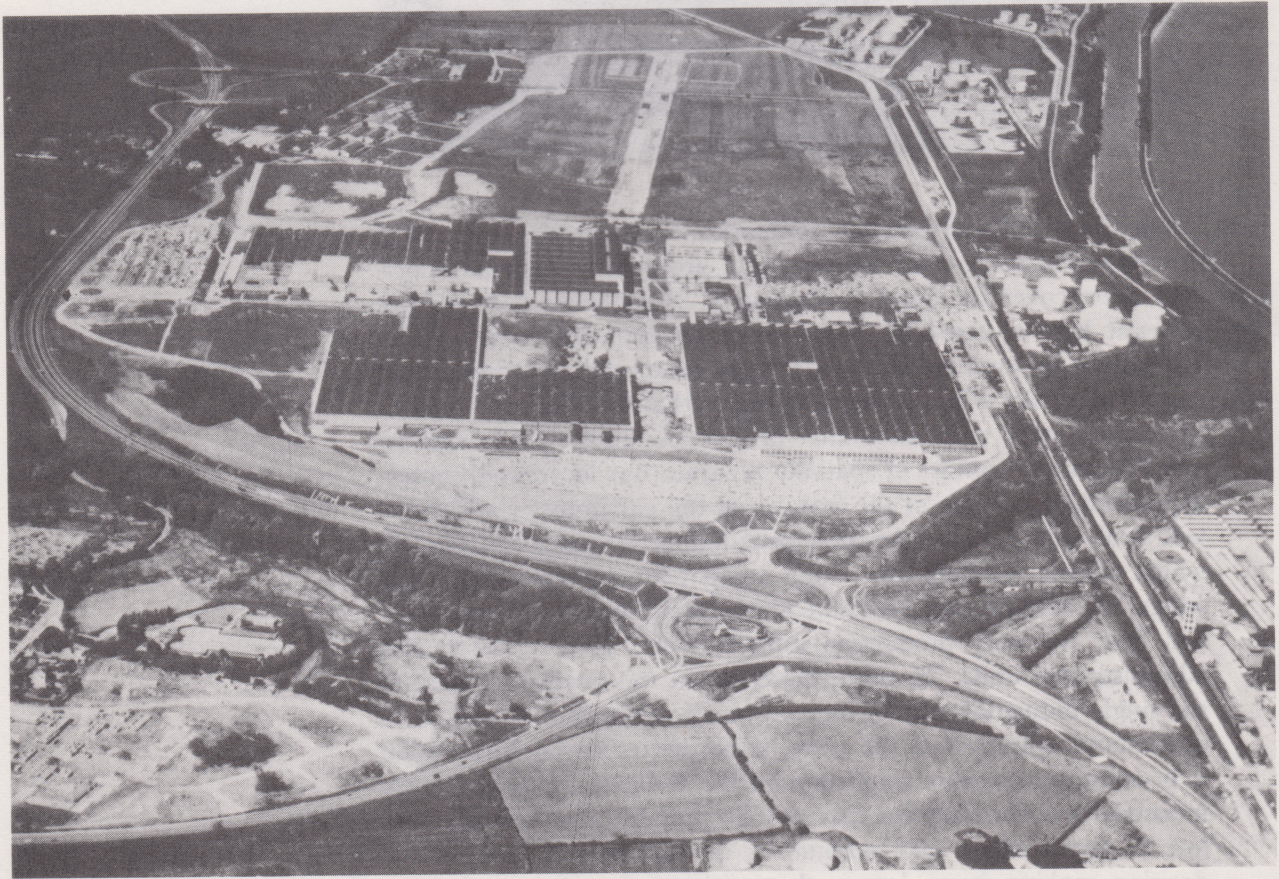


Figure 20.5 Vauxhall Motors factory at Ellesmere Port, Cheshire.

Thus, the development of the corporation and its increasing dominance, its sensitivity to the markets, the appreciation of human behaviour in the decision making process at all scales of production, and the increasing importance of the role of government, detract from the essentially price-oriented concept of industrial location. McNee (p. 205) puts the right perspective on it when he remarks that with the development of the large scale corporation, the geography of price (that of Weber's model) has become fused with the geography of administration (be it that of corporation management or of government).

Perhaps J. K. Galbraith (1969) has summed up the changes which have come on the industrial scene since Weber's model was conceived most tellingly, in his book *The New Industrial State* (pp. 13–14):

Seventy years ago the corporation was still confined to those industries – railroading, steamboating, steel-making, petroleum recovery and refining, some mining – where, it seemed, production had to be on a large scale. Now it also sells groceries, mills grain, publishes newspapers and provides public entertainment, all activities that were once the province of the individual proprietor or the insignificant firm. The largest firms deploy billions of dollars' worth of equipment and hundreds of thousands of men in scores of locations to produce hundreds of products. The five hundred largest corporations produce close to half of all the goods and services that are available annually in the United States.

Seventy years ago the corporation was the instrument of its owners and a projection of their personalities. The names of these principals – Carnegie, Rockefeller, Harriman, Mellon, Guggenheim, Ford – were known across the land. They are still known, but for the art galleries and philanthropic foundations they established and their descendants who are in politics. The men who now head the great corporations are unknown. Not for a generation have people outside Detroit and the automobile industry known the name of the current head of General Motors. In the manner of all men, he must produce identification when paying by cheque. So with Ford, Standard Oil and General Dynamics. The men who now run the large corporations own no appreciable share of the enterprise. They are selected not by the stockholders but, in the common case, by a Board of Directors which narcissistically they selected themselves.

Figure 20.6 *The Shell Centre. London headquarters of the Shell Transport and Trading Co. Ltd., a corporation which produces and markets fuels, lubricants, bitumen, waxes, solvents, detergents, plastics, synthetic rubber, fertilisers and agricultural chemicals.*



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ILLUSTRATIONS

British Leyland Motor Corporation, Fig. 20.4; Camera Press, Fig. 20.6; Paul Popper, Fig. 20.2; Vauxhall Motors, Fig. 20.5

Unit 21

Zoning within Cities



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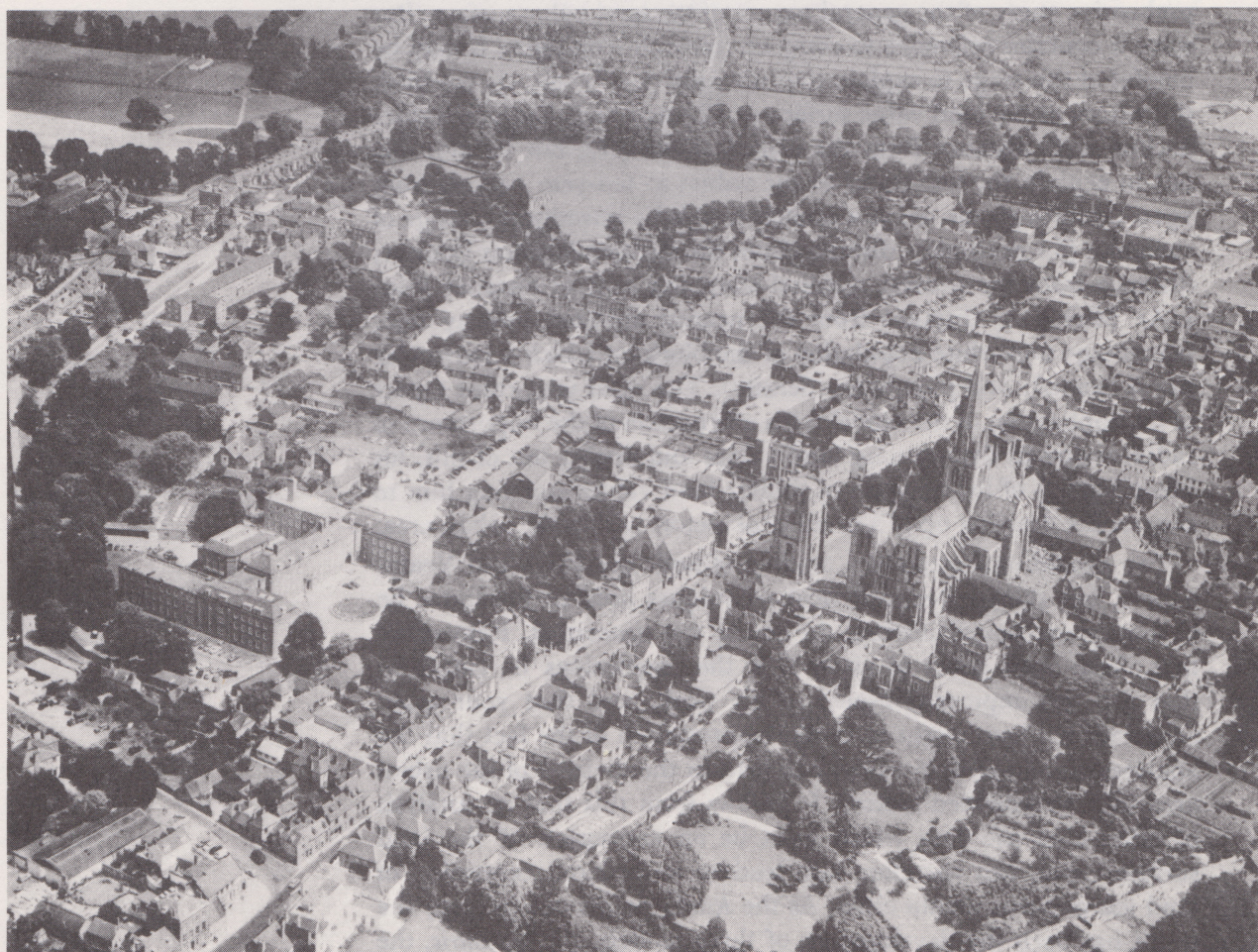
URBAN LAND USE

I INTRODUCTION

Consider a city or large urban area which you know well and imagine that you are walking from its centre to its edge, where residential housing eventually merges into open countryside. You will soon become aware that you pass through different areas, each exhibiting common features, which separate them from the others. You will appreciate the peculiar characteristics of the city centre, the residential suburbs, or the manufacturing district, that make each one a quite distinctive zone. If you care to think about other urban areas, you will probably appreciate that the geographical arrangement of these zones is to some extent repeated. And so you come to recognise that land use in built-up areas follows comprehensible formal patterns. These may reflect the history of the growth of the city or town. They may even reflect attempts by the authority governing the urban area to control land use, perhaps in the interests of the community. But most important of all they reflect such factors as land values (or rent) and accessibility, both of which are closely inter-related.

An explanation of why this should be is given at the beginning of Chapter 21 of the *Reader* by Warren R. Seyfried and myself, first in terms of a simple model very similar to that of von Thünen. For,

Figure 21.1 Chichester; an aerial view looking north-east. The main shopping area is located in the streets running west-east obliquely across the photograph, meeting at the Market Cross just beyond the Cathedral. Post-war housing development can be seen on the outskirts of the city, top centre.



assuming that in the urban area all land is homogeneous, that there is free competition for land in the market and that the processes operating in society are economic ones, the model demonstrates that an orderly pattern of land use emerges, in which all activities making use of land are optimally located and rents are maximised. As in the von Thünen model, rent differentials among homogeneous sites in the urban land market can be explained by rising or falling transport costs. At the centre of the urban area, transport costs will be least but will rise with distance from it. At the centre the maximum economic rent will prevail not only because of low transport costs but also because the supply of sites is at its smallest and only increases with distance from the centre. This means that competing users of land will locate relative to their economic rent potential.

Ultimately the urban land market as just described can be visualised as a rent or land value surface. The market centre will be represented by the peak – the point of highest site value. As rent declines with distance, value falls and land uses change. If sites of equal value are connected in the form of a series of contours, then a configuration of a cone-like structure emerges. This is dealt with in more detail on p. 340 of the *Reader* with a diagram illustrating the land value surface on p. 341. This complete section should now be read from the beginning of Chapter 21.

Whilst the concept of land values and the land value surface is simply explained in theoretical terms in the *Reader*, it is also supported by reference to empirical studies by H. Hoyt in Chicago (*Reader*, p. 341) and by M. H. Yeates in the same city (*Reader*, pp. 342–8). The study by Yeates is certainly by far the most comprehensive study of the general nature of the land value surface. But since it contains reference to complex research techniques it may be helpful at this stage to explain that not only does he clearly establish the nature of the land value surface in Chicago and that land values decline with distance from the centre of the city, but he also sets out to explain the variations in the values at ten-year periods from 1910–60 through the use of a model. In this he introduces a range of variables (for example – distance from the Central Business District; distance from the nearest regional shopping centre; distance from Lake Michigan; distance from the nearest elevated subway line; percentage non-white population of the block on which a particular site is located; and population density). The most important aspect of his application of the model is his affirmation of the importance of radial routes in determining land values and arising out of this, his identification of broad areas of similar land values enabling him to suggest the drawing up of a number of sectors within the urban area.

You should now attempt a reading of both the Hoyt and Yeates papers, but should the analytical techniques used in the latter be beyond your comprehension, do not be too concerned. Remember that, from your point of view, it is the conclusions he comes to that are the important aspect of his work, and that your main consideration here ought to be the appreciation of the fact that the analyses of land surface values can lead to the division of the urban area into well-defined sectors. It follows from this that an analysis of other land use data which must be an expression of the land surface value, can therefore also lead to an ordered expression of land use patterns within cities. As the *Reader* points out (p. 349) the result has been the development of three models, the *concentric*, the



Figure 21.2 The Central Business District, Chicago.

sector, and the *nuclei* theory models, each of which reflects well-defined aspects of the land value surface concept.

2 THE CONCENTRIC LAND USE MODEL

2.1 Basic Theory

As far as the concentric theory is concerned, the assumption is that land values, and by implication accessibility, decline with equal regularity in all directions. As distortions which would be caused by differential accessibility are disregarded (at least in the first instance), land use patterns take the form of concentric zones about a city centre. This model was first put forward at a meeting of the American Sociological Society in 1924, by E. W. Burgess. His basic notion that the main phases in the development of the urban community took place outwards from the central business and retail district, within this series of circular zones, was more precisely formulated a year or so after its introduction, when it became known as the zonal hypothesis of city growth. No further description need be given here of the model since it is adequately dealt with in the

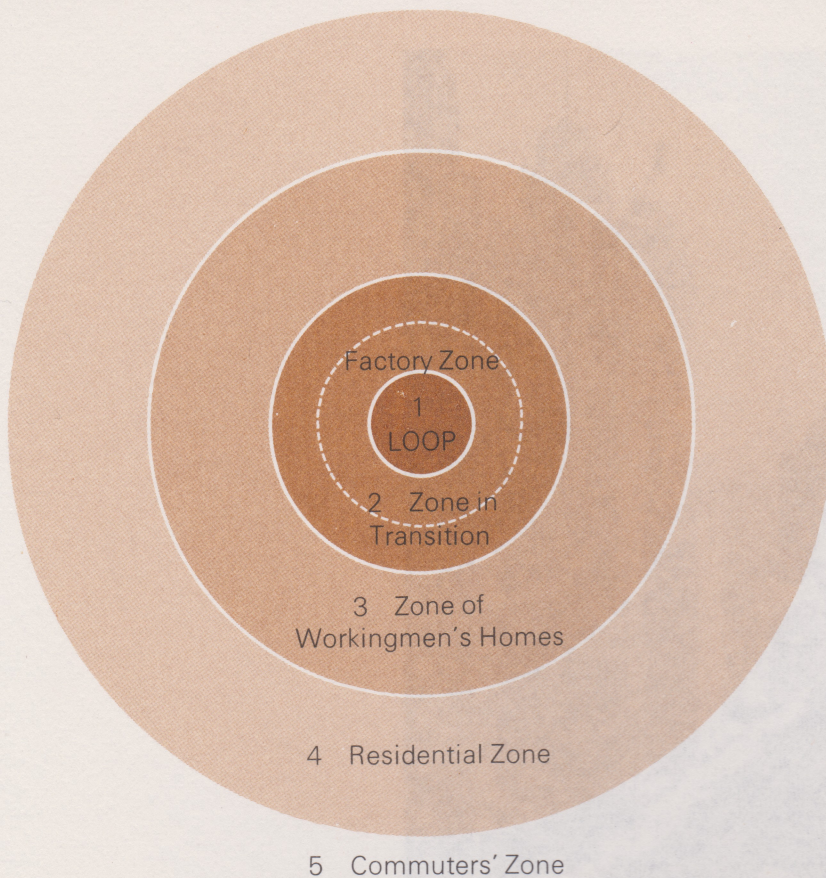


Figure 21.3 The Burgess Concentric Zone model of urban land use.

Reader (pp. 349–51). Suffice it to say that Burgess (1927, p. 178) maintains that it would apply to the contemporary American city although:

all American cities which I have observed or studied approximate in greater or lesser degree to this ideal construction, no one, however, perfectly exemplifies it.

He further states (Burgess and Park, 1925, p. 178) that his model would apply:

in the absence of opposing factors.

These opposing factors included such features as differences in terrain that made some districts more attractive than others for residential purposes and so largely pre-determined the residential areas of the upper classes and working classes respectively; the siting of industry, more particularly of the heavy kind; and the historic survival of an earlier land use in a particular district. Some of Burgess' critics have considered that these factors are found sufficiently often in city areas to invalidate the theory. Burgess maintains, however, that they merely modified the theory, but by no means destroyed it (see Quinn, 1940–1).

It was also in the 1920s that R. E. Park (1929) put forward his concept of the existence of 'natural areas' in the city. They were called this because they were a natural or unplanned function of city growth, often arising from the 'opposing factors' mentioned above. These areas are best described as geographical units distinguished by physical individuality and by the social, economic and cultural characteristics of their population. Some researchers have looked upon the natural area theory to be a separate one from that of Burgess, bearing no relation to the idea of concentric zones. Burgess, on the other hand, had recognised the existence of natural

areas within the broad zonal framework and he therefore looked on Park's work as no contradiction of his own, but rather as an explanation of the social variations that were often apparent within particular zones.

2.2 Assumptions in the Model

Burgess has indeed had to face numerous other criticisms of his theory. To begin with, J. A. Quinn (1950) draws attention to the wide range of what he would consider to be the not necessarily valid assumptions that Burgess has to make. He notes (pp. 120-1) that Burgess has to assume a certain degree of heterogeneity in which the zonal pattern seems to require the presence of widely contrasting types of population within the city:

(1) A large foreign population characterised by different degrees of assimilation. (2) Members of different races. (3) Men and women who pursue different occupations, who enjoy different standards of living, and who control different volumes of purchasing power.

Whilst it seems unlikely that all these elements need be present, according to Quinn, a certain degree of heterogeneity is obviously needed in order that differentiated zones may appear. For example, social class gradations must actually exist if the residential population is to be sorted into bands occupied by different socio-economic strata. Quinn also notes that the theory assumes a mixed 'commercial-industrial' base to the economy of the city. The land uses described as characteristic of the inner zones (the central business district, warehouse and wholesale business district, industrial or factory areas) make it clear that commerce and industry are assumed to be present (Quinn, 1950, p. 121).

In addition Quinn mentions the range of economic and cultural factors that are assumed by Burgess. Quinn thinks, for example, that the model presupposes private ownership of property, economic competition, and the existence of specialised economic institutions occupying distinctive buildings and areas. As far as transport goes (Quinn, 1950, pp. 122-3):

Burgess took for granted the operation of an efficient system of transportation which enables the population of an urban agglomeration to utilise regularly and in person the specialised services of spatially separated utilities . . . Burgess assumed, further, that transportation is equally easy, rapid, and cheap in every direction within the city.

It can also be added that the Burgess theory is based on assumptions about space geometry. It assumes one centre and takes for granted the fact that physical area increases as the square of radial distance from that point. Space is therefore in shorter supply nearer the centre and gets more abundant towards the periphery. The theory also requires an economic assumption about space. It is that the central areas are more valuable because they are in short supply and more accessible to the city area as a whole and therefore subject to great demand. Competition for these sites is the springboard from which change in the spatial structure occurs and it is assumed that a sorting of community units will take place with physical positions mainly determined by economic ability to compete for space.

Finally, Burgess makes assumptions about occupancy patterns on the part of the various socio-economic elements in the community. He appears to take it as axiomatic that the wealthier classes will utilise all the newer and better housing areas, and with radial expansion, these are located at the periphery of the city. Certainly, the theory definitely implies a high degree of locational freedom on the part of the wealthy who can move anywhere, whilst the poor are limited in respect of their residential choices.

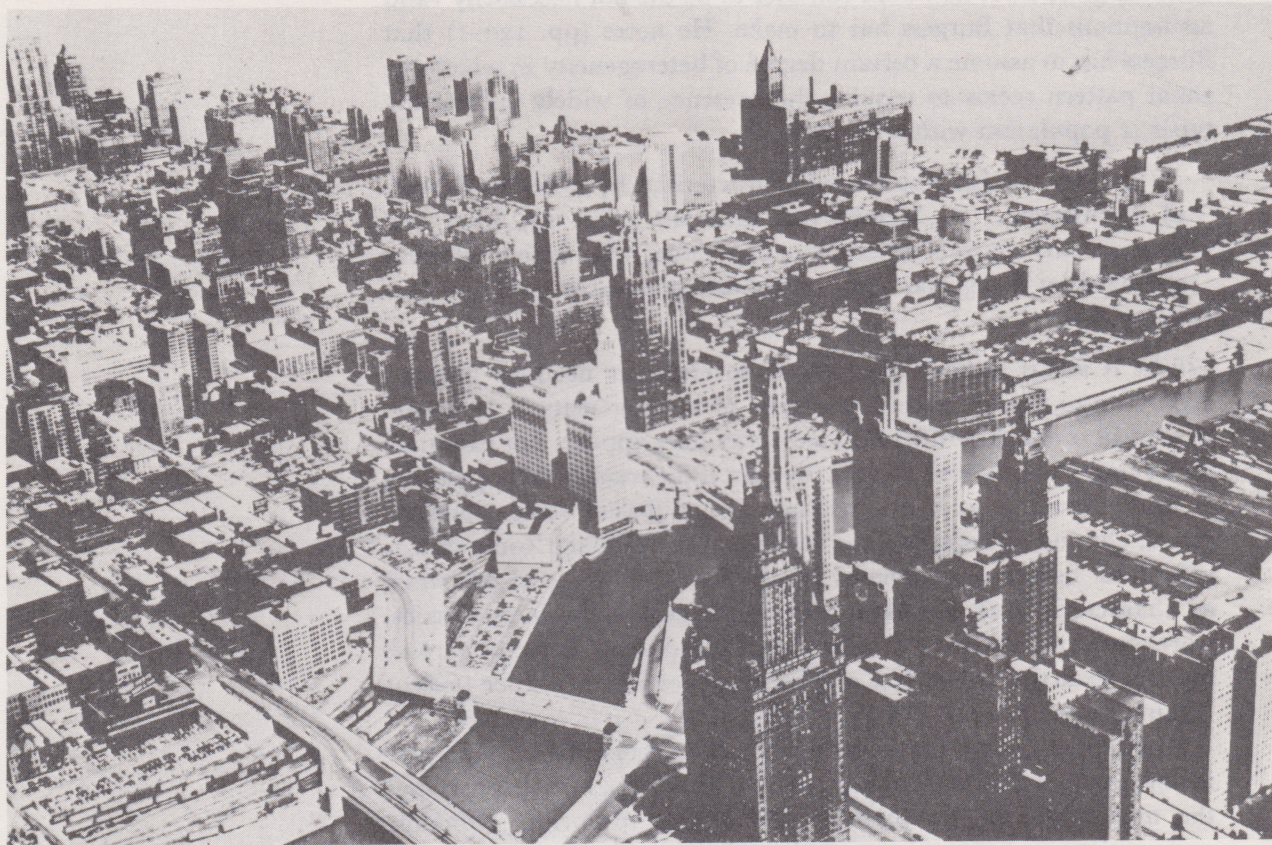


Figure 21.4 High rise apartments in Chicago.

2.3 Some Fundamental Objections to the Concentric Model

Assumptions in the model apart, other perhaps more fundamental objections have been made to it. Indeed the very zonal concept itself has been attacked. One writer, Alihan (1938), re-examined Burgess' data concerning the various gradients with distance from the centre of Chicago (pp. 224-5):

A relatively continuous progression or regression of rates is manifested along radial lines that cut the successive zones. In other words, the five zones, as presented by Burgess, cease to be sharply demarcated from each other, as they appear to be when described in terms of qualitative factors . . . The standard zonal boundaries do not serve as demarcations in respect of the ecological or social phenomena they describe, but are arbitrary divisions. They can be treated only as convenient methodological devices for the classification of data under smaller divisions than the total area included in the particular study. The zone can have significance only if it marks a distinction of gradients or between gradients. Otherwise, if the gradients are as continuous as the name implies, the zonal lines can be drawn indifferently at any radius from the centre. Yet Burgess' description of the five zones

clearly indicates that ecologists envisage these zones as distinct units, differentiated in terms of numerous factors.

If the validity of the gradients cannot be accepted then zones cannot be distinguished as internally homogeneous land use categories.

Another criticism that is closely related to the one just dealt with has to do with zonal homogeneity. Burgess puts forward five homogeneous zones, although a number of land uses, commercial, industrial and residential, apparently characterise the first two zones, and the last one contains a number of different income groups. Nevertheless other researchers have found heterogeneity in the other groups as well, and in particular, Davie (1937), working on a case study of New Haven. His research will be referred to again later.

Then, closely related to this criticism is another based on the discovery of discrepant land uses. These are not predicted in the theory, but are best demonstrated through the work of Firey in Boston. He discovered an upper-class residential area near the commercial half of the city as well as high value lands in the downtown area occupied by Boston Common and the old colonial burying ground (Firey, 1945, pp. 140-8). Although these might be regarded as land use survivals of the type Burgess mentioned in his list of distorting factors, they are certainly not stated as typical of the central zone in the Burgess theory itself.

Lastly, there have been a number of criticisms of the width of application of the theory. Clearly Burgess believed the zonal pattern was to be found in all American cities, whilst Quinn felt it was limited to growing commercial-industrial cities of the United States of America. Other writers, however, have made reference to the value of the theory in relation to their own empirical studies.

2.4 Empirical Studies in Relation to the Model

Some attention has been given to the validity of zonal hypothesis in urban centres in Latin America. L. F. Schnore (1967) has identified seven studies covering three decades that he feels are of significance here. He writes (p. 357):

all of these studies have a bearing – direct or indirect – on the cross-cultural applicability of the Burgess formulation, but one word of caution is in order. The nature of materials to be reviewed obliges us to limit attention to only one phase of the Burgess hypothesis, that is, the portion that is concerned with the distribution of various socio-economic strata between broad zones surrounding the core of the city. In general, we have noted that Burgess posited a direct relationship between socio-economic status and distance from the centre. In other words, the lower status groups are said to be found nearest the centre, the higher status groups at the periphery. In the stylised map of Chicago that accompanied his original presentation, the existence of expensive residential hotels and apartment houses (The Gold Coast) along the lake front indicated Burgess' awareness of an exception to this broad generalisation, and other qualifications were explicitly stated in his later writings, but these may be more appropriately introduced in the sections that follow.

Let us turn directly to the Latin American studies, first examining their descriptive findings, and then turning to certain methodological and theoretical considerations that these studies bring to the fore.

Schnore then reports Hansen's (1934) work on Merida, in which it is indicated that the city has undergone striking changes in the course of population growth, and organisational change. The city centre was originally a square, the area of Spanish residence. Beyond the centre and a zone around it kept for future expansion, areas were set aside for Indian settlement. As the city grew, the centre encroached on the Indian area and they moved farther out. Apparently the traditional spatial pattern had survived until 1900 when breakdown began, but finally a pattern evolved in which there ultimately emerged (Hansen, 1934, p. 141):

an urban pattern approaching that of northern American cities. (Thus) the centre is characteristically a business district rather than a residential district of the aristocracy . . . The wealthy occupy fashionable suburbs and there are certain streets to which the middle class drift.

The whole process of change is seen by Hansen as a direct response to population growth and changes in social and economic organisation, including the emergence of a true middle class. His interpretation is in general conformity with the approach of Burgess for he says (p. 140) that the basis of this sorting process is purely economic.

Schnore then points out that six other fairly detailed reports on individual Latin American cities contain the main themes found in Hansen's research on Merida. First of all, all the writers refer to the existence of the traditional or colonial pattern where the higher status groups are found near the city centre. Secondly, in all cases this pattern is apparently breaking down. And thirdly, there is a tendency for all of the cities in Bolivia, Guatemala and Mexico to move in the direction of the 'North American Pattern'. (See Hayner (1944); Hayner (1945); Leonard (1948); Hawthorn and Hawthorn (1948); Caplow (1949); and Dotson and Dotson (1954).)

This summary might seem to imply that there is evidence of forces at work in Latin American cities that are shaping them in the general direction of the Burgess model, at least with respect to the residential distribution of broad socio-economic strata. This, however, is hardly the case. To begin with, the various authors cited do not offer their material as confirmation of the zonal theory – it is designed to serve other purposes and in many cases arises out of other work. For example, Hayner's study of Mexico City was part of a broader investigation of the spatial distribution of crime. Then relatively little use is made of statistical data that might offer quantifiable evidence in support of the Burgess theory. Further, the only writers who refer to land values are Leonard on La Paz and Hayner on Mexico City, where admittedly they indicate that they found the pattern observed in north American cities by Burgess (that is, land values declining with distance from the centre). The Dotsons in investigating Guadalajara (Dotson and Dotson, 1954) say that they obtained land values for every block in the city, but they do not write these findings up in detail because they report (p. 368) that:

disparities between these values and actual residential land use show this index to be untrustworthy. (Also) rapid expansion in recent years has brought with it speculative fever, and land values, as in the United States, tend to reflect distance from the commercial centre more closely than the nature of residential property.



Figure 21.5 Guadalajara, Mexico.

But still more important in judging the value of these reports in support of Burgess, must be the coverage given to the factors that the originator of the theory himself considered important in terms of independent variables and constants in his model. Above all, the theory put forward by Burgess was formulated to describe growing cities with special stress put upon the distorting factors of local terrain and transportation. Although the research in question does give data on population and most papers say something about local topography, very little information is provided concerning the availability of public and private transport, its costs or the ease with which movement can take place in any direction. As to constants, in the Burgess model factors of growth, heterogeneity and class structure, and type of economic base are all assumed. Schnore (1967) rightly points out that for our purposes the assumption with regard to social classes is particularly relevant (p. 357):

for we have arbitrarily identified changing patterns of residential distribution on the part of social classes as the dependent variable that can be found in all the Latin American studies under review. Further, we have pointed out that a 'breakdown' and tendency towards reversal of the traditional colonial pattern is mentioned in every case.

The upper classes, once in the centre, are moving out, and the lower classes coming in, with the middle classes occupying distinct areas of residence. Thus the differentiation of social classes appears to be a central concern. And yet, as Schnore says, all the research reports

fail to provide a clear indication of the number of classes that might be recognised, their relative size and the changes in them.

Closely connected and of more importance is the question of the economic base which Quinn identified in the Burgess model as 'commercial-industrial'. Bearing in mind the relatively recent industrialisation of Mexico, Bolivia, and Guatemala, some indication of the economic base of the city as referred to in the research would have been valuable, particularly since the situation in each must have been a dynamic one and must have had relevance to residential distribution. However, information in the research reports is scant and uneven.

Lastly, as Schnore (1967) points out (p. 364), the consideration of culture as an independent variable must be important if not crucial since:

it is central to any cross-cultural comparisons.

Burgess most specifically referred his model to cities in the United States of America. He thus assumed culture to be a constant, and variations in the spatial pattern that could be observed in north American cities were presumably to be explained in terms of variations in growth, topography, transportation etc., factors that complicate the ideal zonal arrangement.

Quinn, in his analysis of the Burgess culture said that it assumed a private ownership and control of property and freedom of competition. But how far are these assumptions reasonable in the Latin American context? Is the culture of the urban area likely to be the same as the North American city and if there are differences will the concentric pattern emerge at all in the Latin American situation? Certainly, it seems to be the view of some of the research workers whose writings are under discussion, that cultural differences represent the major factor of explanation of the differences in city patterns between the two Americas. Dotson specifically states this, whilst Caplow makes the point that it is all too easy to ascribe the features of urban development noted by Burgess in Chicago to other cities. He admits that they may be valid as far as the United States of America is concerned and also Europe, but he does not feel them to be true for Guatemala City. Indeed he questions the extent to which it is possible to formulate laws of urbanisation that hold for more than a single culture.

Apart from the seven studies just discussed in detail, Schnore (1967) has examined fifty other investigations of Latin American cities. These seem to give support to the findings of the seven studies, for, as he says (p. 366):

they did not present a distorted picture of Latin American city structure. First of all, elements of the traditional Plaza-centred pattern are almost perfectly ubiquitous. Second, there is frequent reference to changes in the direction of the North American pattern; although direct references to the Burgess zonal hypothesis are relatively rare, it is clear that a movement of the higher socio-economic classes to parts of the periphery is under way in a very large number of the growing cities of Latin America. Third, it is clear that increasing industrialisation of many of these cities is playing an important role in reshaping their land use patterns. Finally it is evident that an accretion of jerry built peripheral slums still characterises most of the larger cities of the region.

TABLE 1

SUMMARY OF CHARACTERISTICS REPORTED FOR SELECTED LATIN AMERICAN CITIES

Authors and Dates of Publication	City	Date and Source†	City Size	Average Annual Growth‡	Publication Contains Descriptions of:			
					Topography	Transportation	Class Structure	Economic Base
Hayner (1945)	Mexico City	1930c 1940c 1944e	1,029,068 1,448,422 1,699,955	3.38%	Yes	No	No	No
Dotson- Dotson (1954)	Guadalajara	1940c 1950e	229,200 378,400	4.91%	Yes	Brief references only	No	No
Leonard (1948)	La Paz	1928? 1942?	135,768 301,450	5.41%	Yes	Brief references only	No	No
Caplow (1949)	Guatemala City	1940c 1948e	186,000 230,000	2.64%	Yes	Brief references only	No	No
Hansen (1934)	Merida	1895c 1930c	50,000 85,148	1.48%	No §	Brief references only	Yes	Yes
Hawthorn- Hawthorn (1948)	Sucre	1930c 1942?	27,508 30,000	0.72%	Yes	No	Yes	Yes
Hayner (1944)	Oaxaca	1940c	29,306	Unknown	No §	Yes	Yes	No

† Population data are those reported in the article; the sources are (e)stimates or (c)ensus reports.

‡ Implied average annual growth rates computed from the population figures reported in the article.

§ Both Merida and Oaxaca are located on level sites, the latter in a fairly large valley; this probably accounts for the lack of attention to topographic features.

These other studies, then, in no way detract from the argument that cultural differences of the type described must undermine the relevance of the Burgess model to the Latin American city. However, would the same constraints apply in the case of studies of other cities where cultural parallels might more legitimately be assumed to exist? One research worker, Elizabeth Gittus (1964-5, p. 6) thinks not and speaks of the successful application of the Burgess model:

in the study of several cities of continental Europe, including Stockholm, Berlin, Prague and Paris and to some extent this country also.

2.5 British Examples of Empirical Studies in Relation to the Model

For Britain, P. H. Mann (1968) has closely examined three cities to find empirical data in support of the statement by Elizabeth Gittus. The cities are Huddersfield, Nottingham and Sheffield. In each he finds an easily recognisable Central Business District compounded of the specialised functions of law, finance and the major shopping complex, with nationally known chain stores such as the British Home Stores, Marks and Spencer and Woolworth. Some local shops are successfully maintained in the area, but Mann notes (p. 79):

with the large financial investment that is now part of all city centre development, it requires tremendous resources for a small local entrepreneur to compete for central sites. A very good example of this type of thing was demonstrated in Nottingham in 1960, when a somewhat old-fashioned ironmongery shop, close

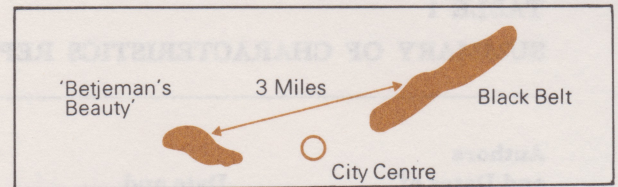
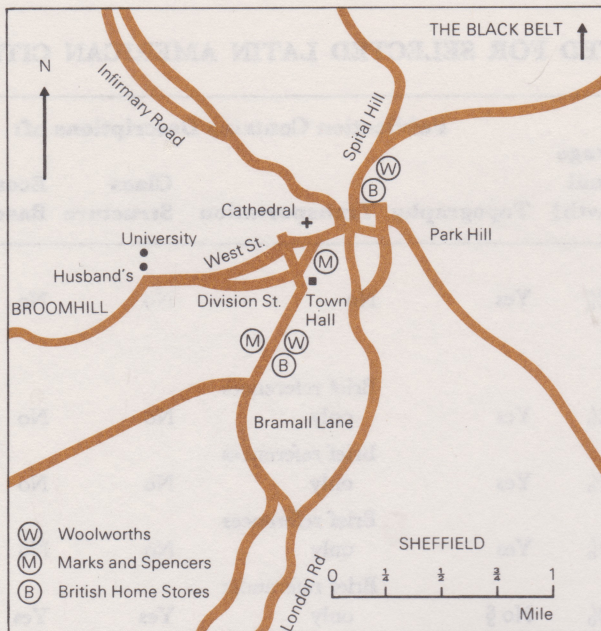


Figure 21.6 (b) Location of industrial and high-class residential areas of Sheffield in relation to the City centre.

Figure 21.6 (a) Simplified plan of Sheffield.

to the city centre, was sold. The sale price of £87,000 worked out at nearly £700 per square yard.

Mann notes the upward movement of the skyline in the Central Business District with new multi-storey department stores such as John Lewis in Sheffield or the multi-occupancy of Norwich Union House in Nottingham. Such ventures have the effect of increasing office spare and the use density of the Central Business District. It also emphasises (p. 79) that:

this district is no longer intended for the small shopkeeper with limited capital – his place is now farther out.

Mann also says that the next zone, which is the one Burgess called the transitional zone, can be referred to as a zone of deterioration or twilight. Its main characteristic is that it is an area of land use change, with former domestic premises tending to be taken over by offices and industry and where residential occupancy is maintained, buildings are converted to flats.

He finds that in all three cities examples of transition are best seen on the sides of the cities which lead to the more middle-class residential areas. But this leads him to discover an omission in the Burgess concentric model where he thinks that scant attention is given to the incidence of industrial areas (p. 89):

Whatever the pattern in America, in this country it is usual in any town or city to find that there is a concentration of industry in a particular part.

In Sheffield, for example, the economic advantages to be gained from firms whose work is complementary being near to each other, is apparent. Makers of cutlery are, for example, associated with cutlery casket manufacturers. Accessibility to transportation is also important. As Mann points out, industry does not locate itself in a random pattern nor in a ring around the Central Business District. Moreover, industry and the older working-class areas are normally adjacent so as to provide easy access between the two, whilst the middle- and upper-class suburbs, whatever their age, are rarely found intermixed with industry, having the economic freedom to

locate away from the smoke and dirt. Sheffield, according to Mann, is an excellent example of this phenomenon (p. 82):

The Sheffield Black Belt which begins on the edge of the Central Business District goes in a north-easterly direction to Rotherham, the boundary between the two towns being of no significance industrially at all. Around this vast area of steel works and engineering works are to be found many of the poorest quality houses remaining in the cities; street upon street of small terraced houses. Moving in an arc on both sides of this to the north and east, are to be found older houses of better quality (the larger bye-law type with semi-detached villas) and older council estates. Moving yet farther around the circle the areas become more middle class, so that on the south-west side of the city centre, there are the most desirable suburbs in the city, all placed within easy access to the Peak District and Derbyshire, and all to the windward of the Black Belt since the prevailing wind is from the west. The extreme hilliness of Sheffield results in numerous

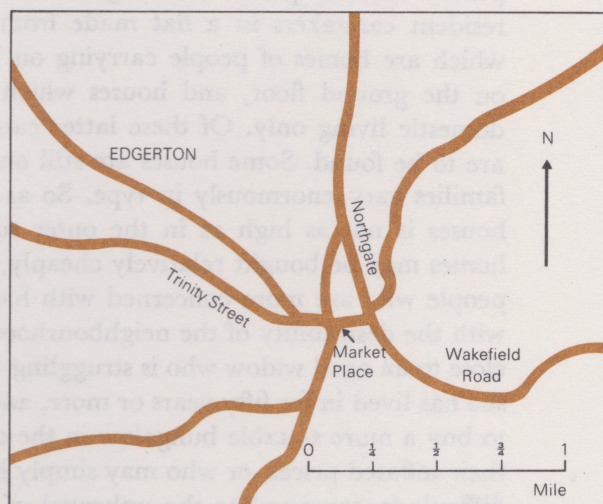
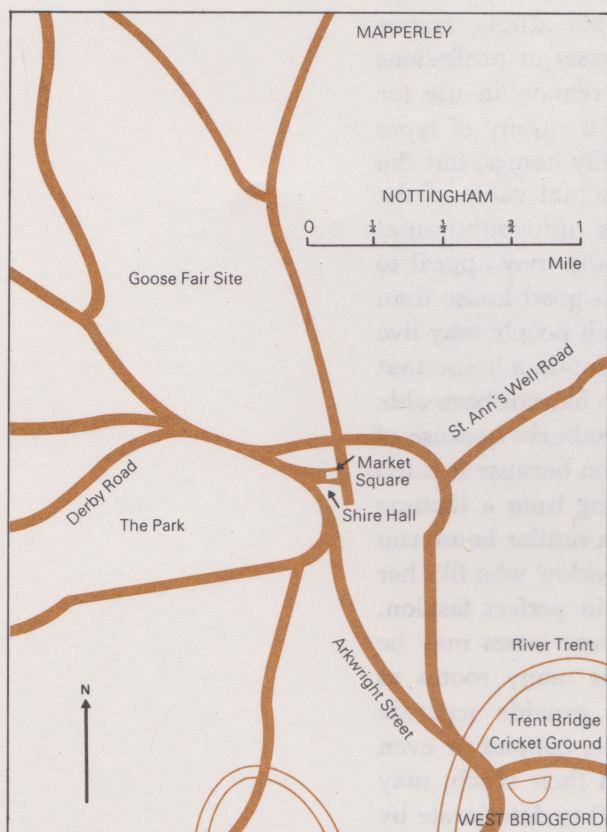


Figure 21.7(b) Simplified plan of Huddersfield.

Figure 21.7(a) Simplified plan of Nottingham.

exceptions to this general plan, with streets of terraced houses in the middle distance range of middle-class suburbs, but it is worthy of note that an area described by John Betjeman as being one of the finer suburbs in England is less than three miles as the crow flies from the heart of the Black Belt, but this three miles is almost exactly on the other side of the city centre from the industry.

As Mann points out, Sheffield therefore shows a division of the city that cuts across the centre rather than radiating out in concentric circles. This has important effects, not least on the transitional zone. Certainly it is common to find in many cities middle-class housing areas which grew up in the nineteenth century now under-

going radical change. This began in the early twentieth century when family size fell, domestic help dwindled and transportation became easier. The movement farther out of the better off, left areas of well-built houses intermingled with streets of smaller terraced houses where their attendant working-class people lived. Mann cites the area near the Nottingham Goose Fair as an example of this phenomenon (p. 84-5):

The houses vacated by single families have seen a variety of uses since their owners left them. Many of those nearest to the city centre became offices, branches of banks, consulting rooms, hair-dressers and so on. At the points closest to the centre it is usual for most houses to become offices. A little farther out there are still many offices, but they become more the smaller type of business with Friendly Societies, Trade Unions and hire purchase branches mixed in. At this stage, too, the business-place-come-house such as is used by dentists, osteopaths and chiropodists is more common, and the area is a mixture of houses which are purely business places (although it is not uncommon to have resident caretakers in a flat made from the old attics), houses which are homes of people carrying on businesses or professions on the ground floor, and houses which still remain in use for domestic living only. Of these latter category a variety of types are to be found. Some houses are still one family homes, but the families vary enormously in type. So as the actual value of the houses is not as high as in the outer suburbs quite substantial homes may be bought relatively cheaply, and this may appeal to people who are more concerned with having a good house than with the desirability of the neighbourhood. Such people may live close to an aged widow who is struggling to maintain a house that she has lived in for fifty years or more, and who has not been able to buy a more suitable bungalow in the outer suburbs because of their inflated prices, or who may simply hang on because it is too difficult to contemplate the upheaval of moving from a lifetime association. Next door, perhaps, there may be a similar house run very efficiently by a more active and younger widow who fills her rooms with lodgers and maintains the house in perfect fashion. Yet again, and especially where ninety-nine year leases may be running out, the house may be let out in as many rooms as possible, with little attempt being made to provide separate washing or cooking facilities, and single people, couples or even families with no better accommodation within their reach, may crowd into the property, which itself may be left to deteriorate by the landlord. In such housing, coloured immigrants faced with tremendous accommodation problems may be expected to find a home.

In this sort of area, then, there is no lack of variety, and one may find a Sectarian Chapel, an Architect's Office, a student lodging house, the home of a decayed gentlewoman and a house of doubtful repute all close together. But this pattern is not repeated in a ring-fashion all around the city, because the old, substantial merchants or businessmen's houses of the nineteenth century were not built all around the centre. Their counterparts on the working-class arcs are smaller houses of the older bye-law type, usually in long terraces fronting straight on to the pavement (or with gardens so small as to be ridiculous) and with yards at the back, private or shared. In these areas family life is still to be

found in the one-house one-family pattern, and these are houses that, when sold, may be bought by coloured immigrants. This type of area is also one where the population structure tends to be loaded towards old age.

In the inner ring of older terraced houses described above, urban renewal is taking place in all three cities, not only in the Goose Fair in Nottingham, but at Northgate in Huddersfield and Park Hill in Sheffield.

Burgess' third zone, that of working-men's houses, is, Mann points out, likely to be a large one since the working class outnumber the middle class by three to one. The question that arises here is whether their houses, usually terraced, are to be found in a concentric ring between the transitional and suburban zones. He implies for any major city an admixture of a middle-class area with some working-class streets (Edgerton in Sheffield, Mapperley in Nottingham and Broomhill in Sheffield). However, a circular journey around these cities at a distance of about a mile from the centre would take one constantly through areas of working-class streets; in some places these would be in a minority and in others the norm. Thus in each case there would be a ring, but of uneven thickness, one which Mann would prefer to generalise as a zone of housing of an older type rather than a zone of working-men's houses.

Burgess' next ring is the residential zone. From his research Mann found that here housing is at least semi-detached with front and back gardens and of a generally higher standard than in zone three. Properties will have been built mainly in the 1920s, and '30s and be of the middle-class type although there will be estates of early council houses. In Mann's view, however, the latter are rarely found on the middle-class side of the city, partly because of land values, partly because of the need to build houses near of access to the work of the inhabitants. Post-war growth in all three cities has been at the periphery of the zone; in middle-class areas styles have been of the pre-war type, but in the council estate areas building has been more imaginative and the lay-out of higher standard (for example, the Greenhill area of Sheffield), with attention given to the concurrent development of amenities. The extension of this zone has in some cases been restricted by Green Belts but in areas it has led to the engulfing of formally independent villages. Dore and Totley, once separate communities, are now part of Sheffield, having been swallowed up by middle-class suburbs. This kind of development makes it difficult to define Burgess' final commuter zone in most British cities. Certainly, according to Mann, there are few cities outside London that have people who can claim to be commuters in anything like the American sense. Only the London to Brighton journey (53 miles) really approximates to the American-style commuting. Most people who work in cities, but live in the country, like those in question here, do not achieve the complete separation of place of work from the community in which they live. More often than not the cities provide functions other than just those of place of work.

Mann decides not to pursue a discussion concerning the applicability of the theory to his three cities, since he accepts that its use is justifiable if it assists in an understanding of the fact that differential areas exist in urban environments. However, his discussion of empirical research clearly indicates that given cultural compatibility which is not an unreasonable assumption, and a

similar 'commercial-industrial base', the model provides, as he says (p. 95):

a rough guide of a valuable sort.

But he implies that even allowing for Burgess' distorting factors, perhaps another model would be of greater use.

3 THE SECTOR LAND USE THEORY

3.1 The Basic Model

Like Elizabeth Gittus, Mann believes the Hoyt sector theory formulated in 1943 and described in the *Reader* (pp. 353-4) to be more valuable – this is quite explicit in that part of his analysis of empirical data where he describes the variations in the thickness of the concentric zones. Indeed he points out that Hoyt's sector theory is of particular value in drawing attention to the expansion of cities in wedge-like fashion (Mann, 1968, p. 75):

Thus, upper class residential areas tend to lie on one side of the town, rather than in a ring all round the centres. Similarly, industry tends to have its side of the town and to expand along transport routes.

The facts of his research echo this statement and he rightly adds that Hoyt's theory is really a refinement of the Burgess model and not a rejection of it since it is based on the circular concept.

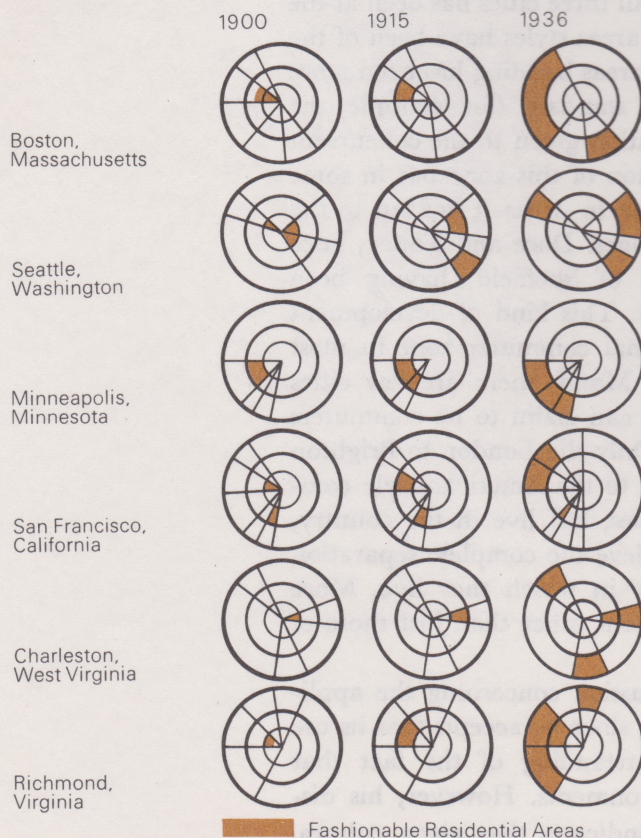
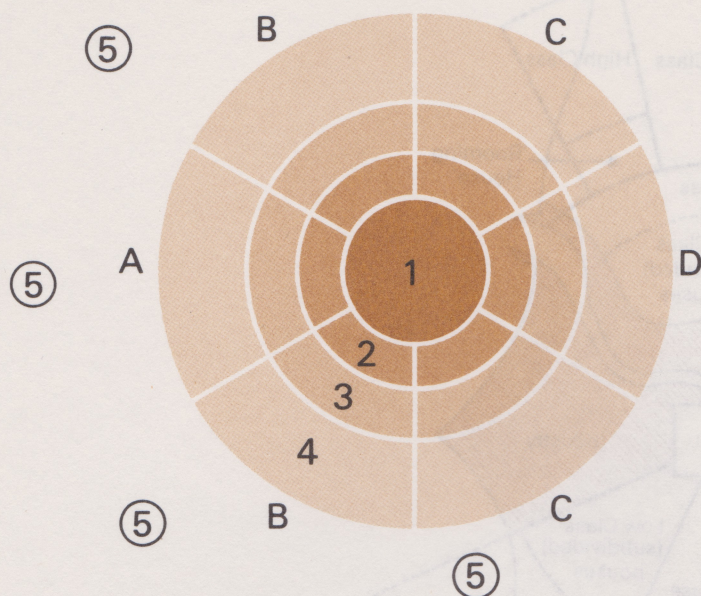


Figure 21.8 Shifts in location of fashionable residential areas for six United States cities.

To take this point in greater detail, once a district with high-class



1 = The City Centre. 2 = Transitional Zone. 3 = Zone of Small Terrace Houses in Sectors C and D; Larger Bye-Law Houses in Sector B; Large Old Houses in Sector A. 4 = Post-1918 residential areas with post-1945 development mainly on periphery. 5 = Commuting distance 'villages'. A = The Middle Class sector. B = The Lower Middle Class sector. C = The Working Class sector (and main municipal housing areas). D = Industry and lowest working class areas.

Figure 21.9 Hypothetical structure of a medium-sized British city.

housing has been established, the most expensive sites for new houses will lie along the outer edge of this area. The ultimate result over a period of urban growth is that a zone of high-class housing tends to be located on one side of the city rather than in a continuous ring. Although better-class housing may extend outwards in a sector, at the same time the age of the buildings is more likely to show a concentric arrangement, as layer on layer of houses is added to the urban fringes. Hoyt(1939), in his study of thirty United States cities, showed in diagrammatic form how high-rent areas, that is the best residential areas, migrated outwards. In other words, these cities (see opposite) show elements of both a concentric and a sector structure. Thus it was that even Burgess' most fervent supporters were quick to concede that the type of radial expansion postulated by Hoyt, with distances from the centre measured on a time-cost basis, would still be found compatible with the concentric zone pattern (Quinn, 1940, pp. 448-77).

Returning for a moment to the work of Peter Mann it is of interest to note that following his empirical studies of Huddersfield, Sheffield and Nottingham in relation to the Burgess model, he evolved a structure for a typical medium-sized British city which recognised the possible co-existence of the two theories.

His city, shown in the diagram above (Fig. 21.9), is medium sized with one centre and allows for commuting from separate villages outside it. It assumes a prevailing westerly wind, with the result that the best residential area is located on the western fringe of the city and on the opposite side from the industrial sector.

But the link between the two theories and their relationship is perhaps particularly well exemplified in Smith's interpretation of

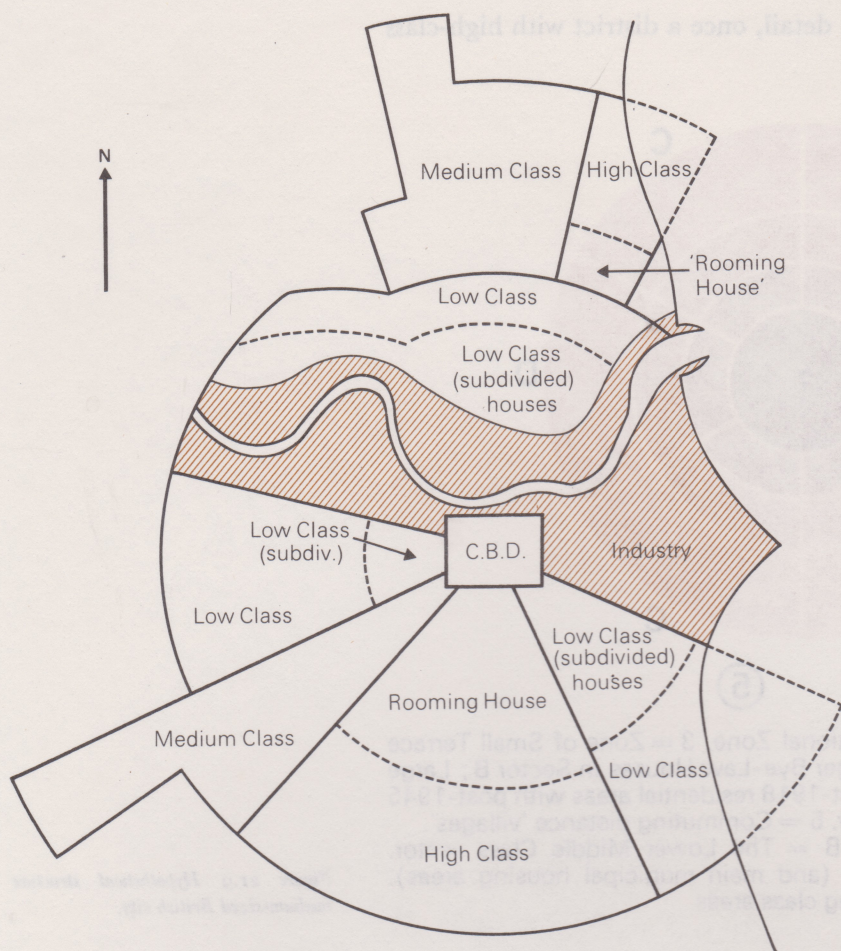


Figure 21.10 Idealised model of ecological areas in Sunderland, 1963.

the land use of Calgary in Canada. His research is quoted in the *Reader* (pp. 354-7). Here emphasis is laid on the greater value of the sector theory in analysing the more recent (1961) situation, whilst the concentric theory seems more appropriate to the earlier stages of the city's growth.

3.2 An Empirical Study in Britain

In Britain, B. T. Robson has suggested a model of urban growth for Sunderland which also combines the two theories. In his book *Urban Analysis* (1969) he describes how he arrived at the division of the city into the ecological areas shown in the diagram above (Fig. 21.10).

This is of particular value, not only for the empirically derived support it provides for both theories, but also for the references made in it to other important research papers in this field. Commenting on his diagram, Robson states that the residential pattern in the north of the city has some elements of the sectoral developments suggested by Hoyt in that the highest-rated area forms a partial sector next to the seaboard amenity area. All the same, in the main, the northern area is in the form of a series of Burgess-type concentric rings, progressing out from a poor sub-divided zone next to the industrial area by the river, through a medium-rated area extending to the east-west railway line, and to a higher-rated zone north of this and running to the city boundary. South of the river, residential areas are like Hoyt's sectoral model with a low-class sector in the east, divided at its northern apex; a highly-rated sector next to it which extends from the inner areas in an expanding area to the southern boundary; a middle-class sector running west; and

lastly a second low-rated area next to the industrial zone by the river.

The development of a rooming-house area towards the townward end of both highly-rated sectors, north and south of the river, is in agreement with Hoyt's theory. As Robson says (p. 129):

it is interesting to note the juxtaposition of sectoral development in one part of the town with concentric ring development in another.

He also mentions other evidence in support of similar tendencies in the United States of America and Britain in cities of like cultural and 'commercial-industrial' base. In particular he refers to the work of Jones (1960) who finds a juxtaposition of sectors and zones in his work on Belfast. The area to the east of the river Lagan has developed concentric zones, whilst that to the west has developed sectors. Again, if the data given for New Haven by Davie (1937) are plotted, a pattern similar to both Sunderland and Belfast seems to emerge. Robson adds that:

the many similarities in the forms which the residential patterns in all three of these examples have assumed, can help to offer a holistic explanation of the juxtaposition of sectors and concentric rings which have been noted.

Each town is river-based with the industrial zones close to the river. The Central Business District is also close but not adjacent to the river. Concentric zones are found in those residential districts which lie on the bank opposite to the Central Business District. Sectors are found in those residential districts which lie on the same side of the river as the Central Business District.

Robson then suggests the mechanisms which result in these common features (pp. 130-1):

Two principal factors might be taken into account; attraction to the Central Business District and repulsion from industrial areas. The resolution of the balance of these forces in a river-based town gives rise to the juxtaposition of sectors and zones arranged in the manner that has been noted. The focus around which the residential areas of a medium-sized town are orientated is the Central Business District. This is the retail and entertainment centre which exerts much of the centripetal force which is responsible for the creation and maintenance of towns. In the case of the professional workers, the Central Business District is also usually the place of work. We can thus see that the object of selecting a residential location within a town is to achieve maximum accessibility to this point while at the same time meeting other requirements such as a good site, open land, access to the sea, of high social value. Thus accessibility is the first of the two considerations. The second prime factor – avoidance of industrial areas – is one which, as has been noted, was stressed by Davie, and one which Hoyt recognised without stressing. Indeed, the importance of the repulsive effects of industry on the pattern of invasion and the movement of the highly-rated sector in the Hendon area, where it was seen to be responsible for the westward spread of decay and substitution of a concentric pattern by a sectoral one, has already been underlined. Especially in industrial towns like Sunderland (or Belfast, or New Haven, or Chicago) where industry is largely heavy and noxious, the patterning of the

residential areas has to be viewed in terms of the location of industrial uses.

The interplay of these two forces can therefore be held to be primary in determining residential patterns. The highly-rated area will tend to be located in such a position that it is at once accessible to the Central Business District and yet not adjacent to industrial areas. And indeed this offers an explanation for the



Figure 21.11 Riverside industrial development in Sunderland.

juxtaposition of sectors and concentric zones on opposite sides of the river. On that side of the river on which the Central Business District has developed, access to it can be achieved directly without contact with the industrial areas of the river banks, whereas on the opposite side of the river, direct access between the highly-rated area and the Central Business District would involve building highly-rated houses adjacent to the riverside industrial areas. To avoid this, a low-rated concentric zone is, as it were, allowed to interpose itself between the highly-rated zone and the industrial area, so that a concentric pattern develops which permits the maximum possible access between the highly-rated area and the Central Business District without there being physical contact between highly-rated housing and industrial areas. Thus, for the highly-rated areas on both sides of the river the two objectives have been achieved; in one case by interposing the Central Business District itself between the highly-rated area and industry; in the other, by using an intervening low-rated area as a buffer. The

resolution of the balance of these two forces of attraction to the centre and repulsion from industry, thus produces the juxtaposition of sectors and concentric zones on opposite sides of the industrial belt, which, in the case of Sunderland and the other towns cited, forms along the line of the river. The highly-rated area forming a concentric ring on the opposite side of the river to the Central Business District might be expected to develop at a later date than the sector-wedge highly-rated area, as indeed was the case in Sunderland.

3.3 Criticisms of the Hoyt Model

Apart from the work just discussed, which considers the concentric model as well as the sector, Hoyt's theory has on the whole been subjected to remarkably little testing or critical analyses of the kind that was so apparent during the analysis of the Burgess model. Perhaps as far as criticism is concerned this is because Hoyt's original work was based on such a wealth of empirical evidence – it will be recalled that he used data from thirty American cities. Nonetheless at least one researcher, Walter Firey (1947), who carried out a land use study of central Boston, claimed to have found evidence there which contradicted aspects of the Hoyt theory. To begin with, he questioned the validity of comparing the results of work in a number of cities where relief, location on a waterfront, and other factors affected the sector pattern of some cities so markedly. He also questioned the whole cartographic approach to land use theories, claiming that at best maps can only give clues to theories that need to be worked out in terms of abstract concepts. Finally he mentioned that Hoyt had not sufficiently considered the roles of cultural and social systems in conditioning land use. Whilst it is certainly right to draw attention to these points, it seems that Firey is hardly offering criticisms which totally invalidate the theory – rather they would circumscribe it in particular circumstances.

3.4 Hoyt Reappraised

Perhaps more to the point is Hoyt's (1964) reappraisal of his own sector theory in a review he made of classical urban structure models, given the changes that had occurred in urban living since 1939. Is it still true, he asked, that high-rent areas are located in one or more sectors of the city and do not form a circle completely around it? This was what in effect he had claimed when he originally formulated his theory. He answered that in general the high-income families are still definitely concentrated in certain sectors. However, he realised that the car is opening up large regions beyond existing settled areas and that there is greater flexibility in urban growth patterns resulting from radial expressways. As a result he was able to point out that certainly in the U.S.A. some higher-income communities have developed beyond low-income sectors, though as Hoyt pointed out, they usually do not enjoy as high a social rating as new neighbourhoods located in the high-income sector.

4 THE MULTIPLE NUCLEI LAND USE MODEL

The above analyses of land use using the concentric and sector models are only of real value, however, in a discussion of cities with one clearly defined central area, even taking account of the possible

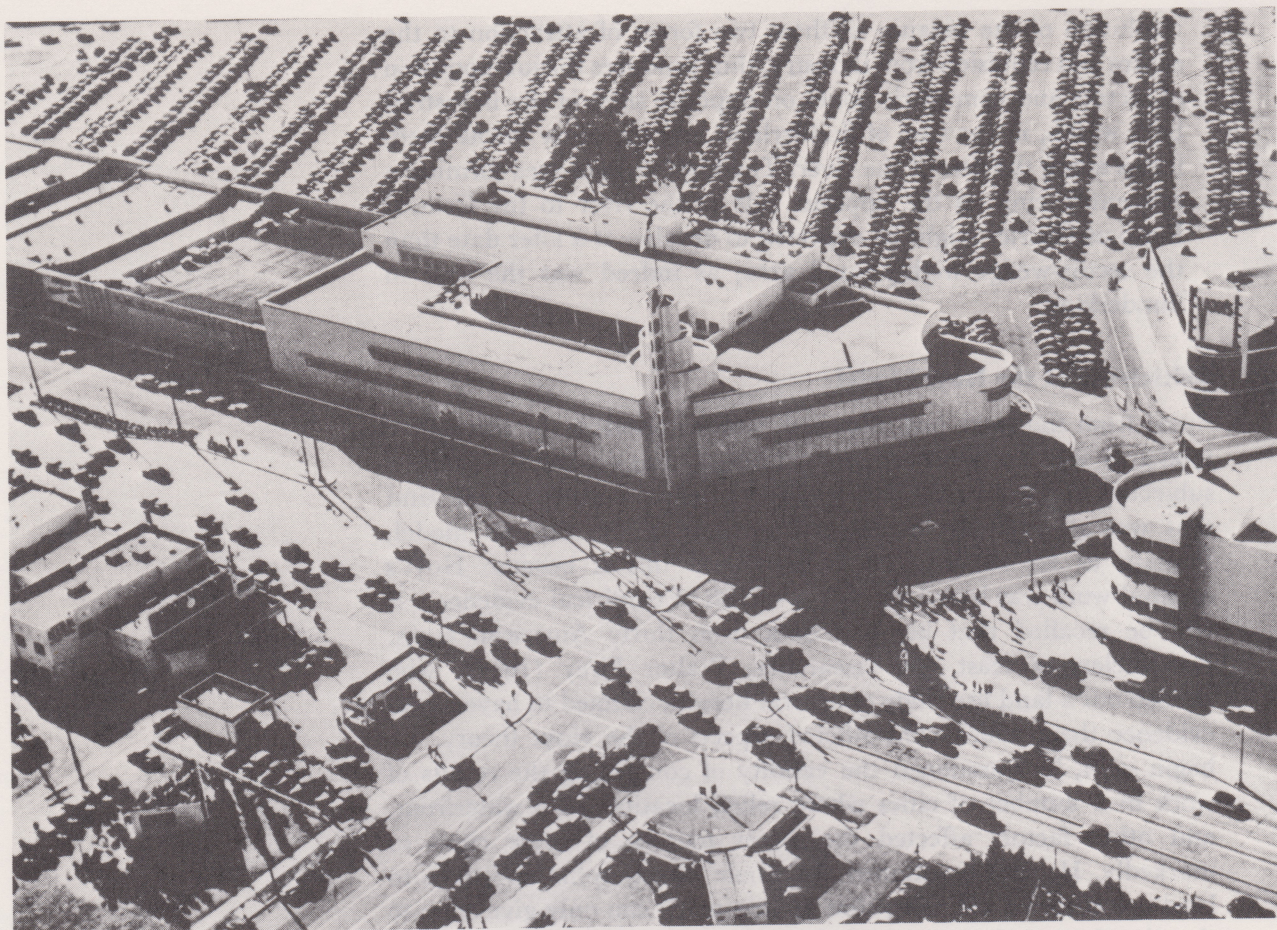


Figure 21.12 Recently developed shopping precinct at Grensham, an industrial centre on the outskirts of Chicago.

objection to their universal application. Indeed your reading of Smith's work in Calgary (*Reader*, pp. 354-7) will have already made it apparent that with cities which have more than one centre, a better land use explanation is likely to be provided by the multiple nuclei model propounded by C. D. Harris and E. L. Ullman in their paper 'The Nature of Cities', which is quoted in the *Reader* (pp. 357-8). Their model suggests that cities have an essentially cellular structure in which distinctive forms of land use have developed around certain growing points, or nuclei, within the urban area. The use of separate foci reflects a combination of a number of factors; for example (1) certain activities require specialised facilities, (2) certain activities group together because such a close association can be profitable, (3) certain activities are detrimental to each others' interests and therefore tend to keep apart, and (4) certain activities are unable to afford the rents of the most desirable sites. Then, of course, it has to be remembered that the number of nuclei to be found in any given city is a result of the historical development of that urban area and the operation of localisation forces within the city. Harris and Ullman then describe the several types of districts that have developed around nuclei in most large American cities, including the Central Business District, various types of manufacturing districts, the residential district and so on. Harris and Ullman therefore allow for a much more complex land use situation than either Burgess or Hoyt, and their paper should now be read.

It is perhaps worth noting that a more sophisticated interpretation of the multiple nuclei model may be made in cities with only one central business district but with many sub-centres serving the needs of smaller communities within the urban area. Here the concern is

only with retail land use, but residential districts can be grouped around these retail sub-centres so that in the suburban areas of large cities there may exist a multi-centred pattern. M. J. Proudfoot (1937) was the first to describe this phenomenon in his work on Philadelphia. This, interestingly enough, leads us now to consider a much more recent article by Ullmann (1962), in which he reconsiders his original paper with Harris on the multiple nuclei theory. He makes the point that there is now a growing feeling that the Central Business District may lose its unique qualities and that it may become just one of many centres in the city, though it will still remain the most important one. Thus it could be the shopping centre of the large low-income area around it and an office centre on a reduced scale for older activities or smaller concerns that can use poor vacant space or large amounts of cheap labour. Ullman thinks that the high-grade activities now attracted to the Central Business District because of its hierarchical predominance will abandon it for centres better located for the serving of the high-income areas. In this manner, he explains, the dominant nuclei will proliferate. Ullman also predicts that other centres will develop on a regional or specialised basis, so strengthening the notion of multiple nuclei generation. He draws attention to the nuclear function of airports which must of necessity be close to the edge of cities and which will increasingly draw conventions and out-of-town visitors; the outlying shopping centres that will handle retail trade; the large new factories and other employment centres which will in future be on the city outskirts on large tracts of formerly unused land; and the specialised entertainment, educational, cultural and recreational centres that will be scattered over the city to serve the whole population.

5 CONCLUSION

In concluding our consideration of the concentric, the sector and the multiple nuclei models we should perhaps first of all summarise the differences and the similarities between each. To begin with, the concentric theory and the multiple nuclei theory deal with the whole urban population, whereas, in contrast, the sector theory is primarily concerned with residential land use. Then, for the most part, the concentric zone and sector theories consider the urban area as having only one centre, but the multiple nuclei theory takes account of various centres as nuclei. All three of the models have been criticised on the grounds that they represent only the predominant land use at any given location. Some critics have indeed been particularly concerned about the way in which the multi-occupancy of high-rise buildings, now becoming increasingly common in city areas, is not properly accounted for by the land use models. However, many such blocks contain the offices of concerns of like type and one should not over-estimate the 'noise' factor created in the models by multi-occupation.

Secondly, in this concluding section it is reasonable to question whether or not we should draw any conclusions about the relative merits of the three land use models. Certainly no one can deny that the concentric zone theory can be seen to apply in very general terms to the Western city with the commercial-industrial base that has developed about a major single centre. We could hardly expect in such a city to find sharply defined zones, each of uniform width throughout. Indeed distortions due, as we have seen, to factors of

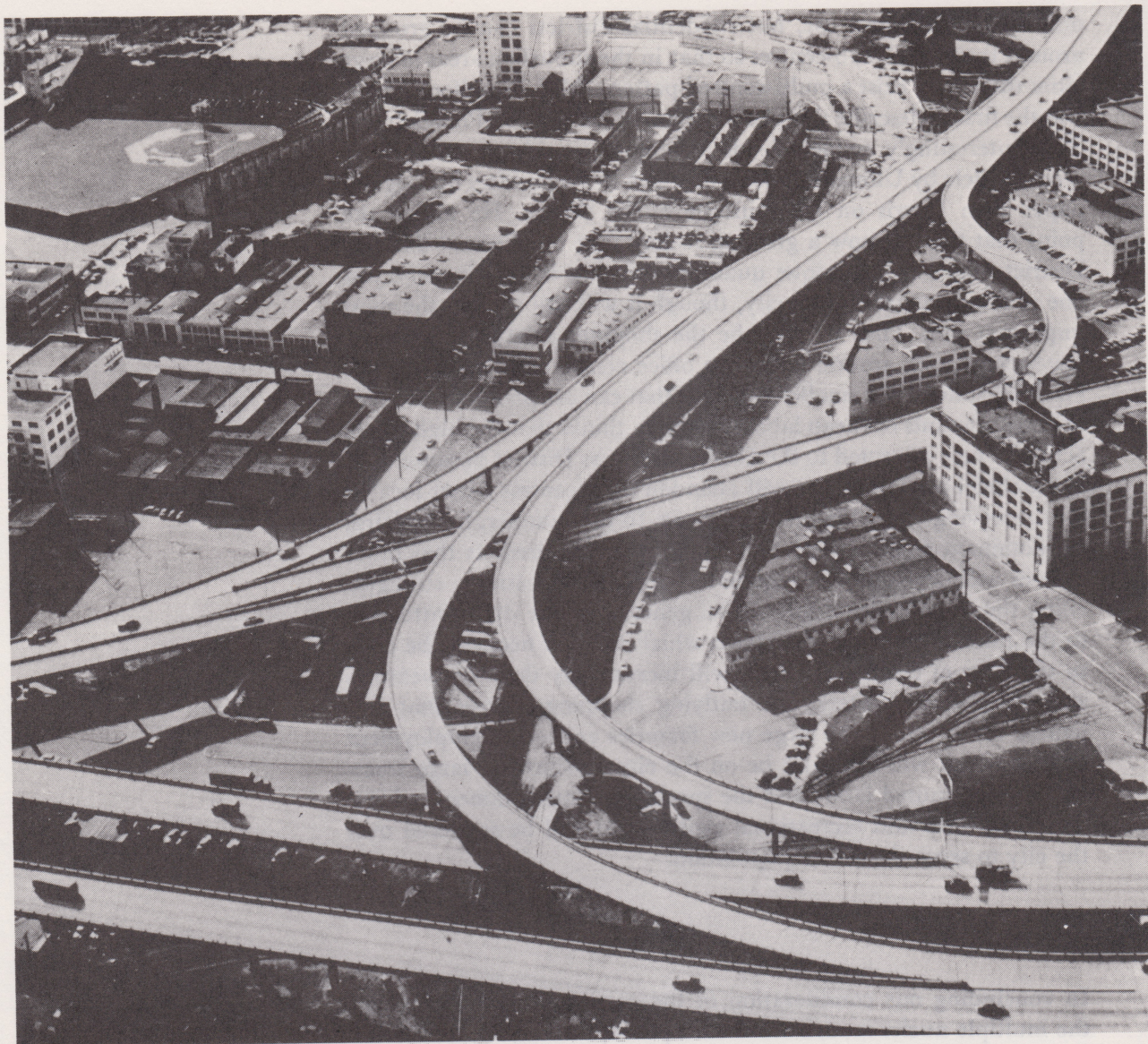


Figure 21.13 Expressways leading into the centre of Chicago.

contrasting relief or the presence of a heavy manufacturing belt along a transport line cutting across the zones, are to be expected. All the same it would be true to say that the concentric zones were more in evidence before the now widespread use of the motor vehicle improved the mobility of labour.

Certainly, elements of the sector theory are to be seen in most growing urban communities. The maintenance of residential quality throughout sectors was initially demonstrated by Hoyt, but even he had admitted that by the 1960s this concept was undergoing some modification. In the future the influence of the car is likely to further lessen this conformance in the growing outer sections of large urban areas.

As to the multiple nuclei model, in many ways it is simpler than the other two and is able to adjust more easily to contemporary conditions. It seems to be a theory that fits the highly flexible urban environment. Whereas the motor vehicle has lessened the applicability of the concentric zone and sector theories, the multiple nuclei theory seems to fit even better as a result of transport changes.

All the same, in the last analysis it should be remembered that all three models are not mutually exclusive and today elements of all three can be expected in many urban areas. This is particularly well demonstrated where cities have fused together to form the very large

conurbation or megalopolis, the term used by Professor Jean Gottmann (1961) to describe the urbanised north-eastern part of the U.S.A., which stretches from southern New Hampshire to northern Virginia and from the Atlantic shore to the Appalachian foothills. In such an area the internal land use patterns are very complex.

Elements of all three models are also to be found in the work of Smith in Calgary and, as the *Reader* makes clear on p. 358, that of Haggett in Cambridge, where the spread of housing since 1945 shows definite gradients close to the city, along major radials and in the outlying villages. These have been identified with the concentric, sector and nuclei models respectively.

However, whatever the merits of the models in describing urban land use, it should also be borne in mind that they are concerned with a structure that has been produced by the processes of city growth. This clearly implies a dynamic situation in terms of urban land use in which patterns evolve in response to the changing demands of the urban community. In the concluding section of Smith's work on Calgary, quoted in the *Reader* (pp. 358-61), he rightly spells out this point in some detail, emphasising, as all the models have done, the central universal role of transportation.

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TEXT

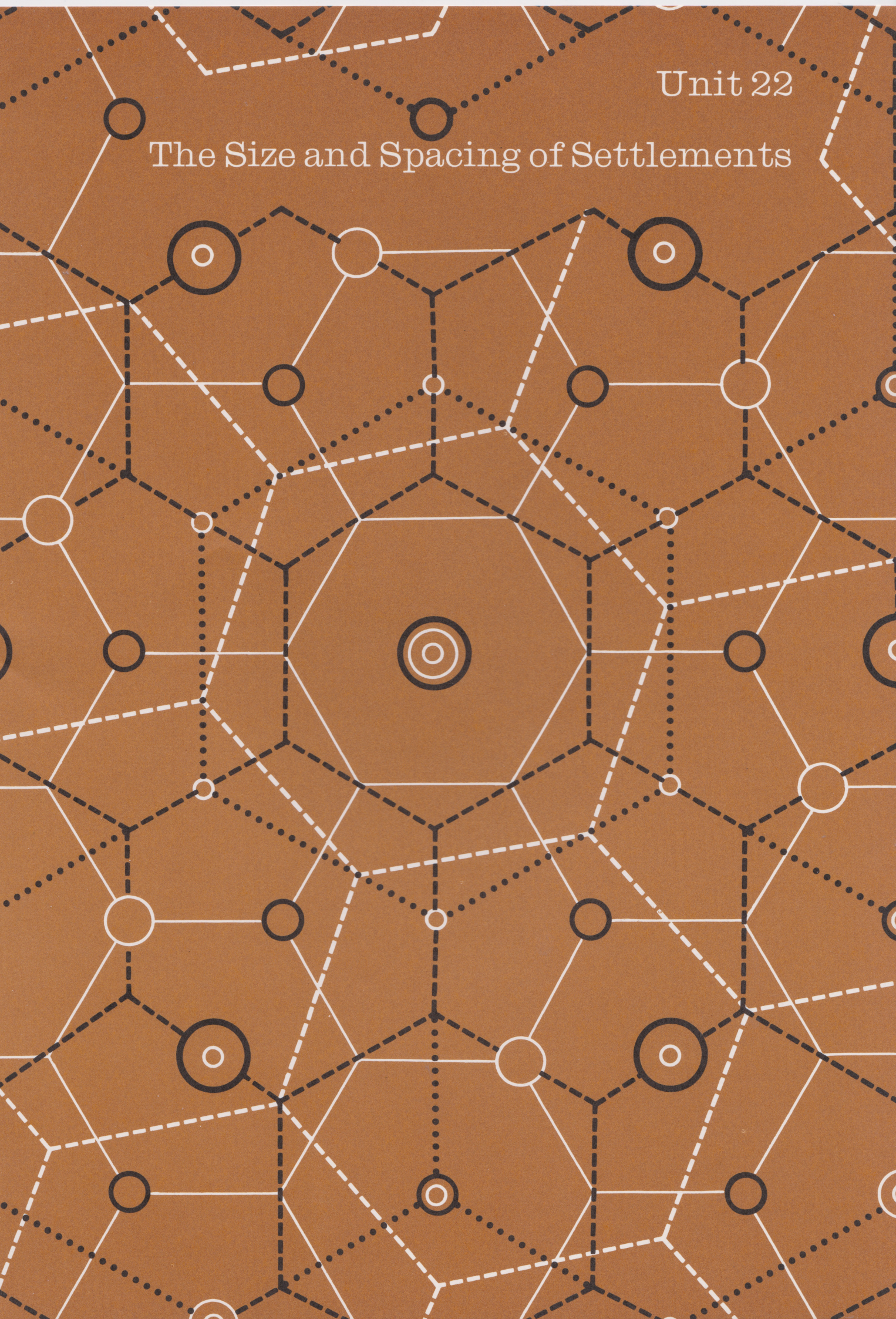
American Sociological Society for E. W. Burgess, 'The Determinations of Gradients in the Growth of the City' in *Publications of the American Sociological Society*; Cambridge University Press for B. T. Robson, *Urban Analysis*; Columbia University Press for M. A. Alihan, *Social Ecology: a Critical Analysis*; F. & L. O. Dotson, 'Ecological Trends in the City of Guadalajara, Mexico' in *Social Forces*, Vol. 32; Prentice-Hall Inc. for J. A. Quinn, *Human Ecology*; Routledge & Kegan Paul Limited for P. H. Mann, *An Approach to Urban Sociology*; University of Chicago Press for E. W. Burgess and R. E. Park, *The City*; John Wiley for L. F. Schnore 'On the Spatial Structure of Cities' in *The Study of Urbanisation*, ed. P. M. Hauser and L. F. Schnore.

ILLUSTRATIONS

Aerofilms, Figs. 21.1 and 21.11; Aerofilms and Ewing Galloway, Fig. 21.4; Cambridge University Press, Fig. 21.10 in B. T. Robson, *Urban Analysis*; University of Chicago Press, Fig. 21.3 in E. W. Burgess and R. E. Park, *The City*; Department of Housing and Urban Development, Washington, Fig. 21.8 in *The Structure and Growth of Residential Neighbourhoods in American Cities*, 1939; Mexican Tourist Office, Fig. 21.5; Routledge and Kegan Paul, Figs. 21.6a, 21.6b, 21.7a, 21.7b, 21.9 in P. H. Mann, *An Approach to Urban Sociology*; United States Information Service, Figs. 21.2, 21.12, 21.13.

Unit 22

The Size and Spacing of Settlements



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THE SIZE AND SPACING OF SETTLEMENTS

1 INTRODUCTION

The need to consider the size and spacing of settlements and their relation to the rural zones which surround them is discussed in the opening section of Chapter 22 of your *Reader*, under the heading of 'Settlement Pattern Analysis'. You should now study this if you have not done so already. One of the most important aspects of this piece of writing is the attention it draws to the importance of the discussion of what is known as Central Place Theory.

2 CENTRAL PLACE THEORY

This theory, first set out by Walter Christaller in 1933, analyses the role of towns and cities as central places – that is settlements concerned with the provision of goods and services. This function may include administrative, financial, and other similar services, as well as those of retail and wholesale trade. Such services obviously need to be located so as to give maximum accessibility to the people who use them and so they tend to cluster in market centres visited by the customers from surrounding areas. Some services are more specialised than others and it appears that the larger the number of potential customers tapped by a central place, the more specialised its services become. The result is a system of central places of varying sizes showing a degree of regularity in their distribution across the landscape. It was the recognition of this phenomenon from evidence gained in south Germany that encouraged Christaller to formulate theoretical generalisations about the distribution and size of central places.

2.1 The Limited Nature of Central Place Theory

But as the introduction to the section headed 'Central Place Theory' in the *Reader* (p. 362) makes clear, this concept is far from a perfect explanation of the size and spacing of all settlements since it is only concerned with the evolution of urban units as *service centres*. It has to be remembered that other factors will be important in determining the size and location of an urban centre as well as its relation to the surrounding countryside. Apart from the service function of the central place, J. H. Johnson (1969 A, p. 76) in *Urban Geography* records three other determinants:

- (1) those cities or towns that have grown because of a location that links an area to the outside world or with certain types of manufacturing;
- (2) the availability of highly localised physical resources;
- (3) the chance element or human whim in urban location and development, a factor which is often overlooked because it is so difficult to assess.

He then considers these determinants in greater detail beginning with the effect of the distribution of through routes and 'break of bulk'

points along them in relation to (1) above. It should be added that break of bulk points occur where cargo is transhipped from one transport media to another. Johnson continues (1969 A, pp. 77–8):

Incidental to its primary function, a through transport route often modifies the pattern of local accessibility in an area, since it can hardly fail to have an effect on local transport facilities. As a result a through transport route can distort the central place arrangement of the cities and towns near to it. In Britain, for example, the London to Birmingham motorway, designed to connect two major conurbations, has also had a considerable impact on the local accessibility of towns close to its route.

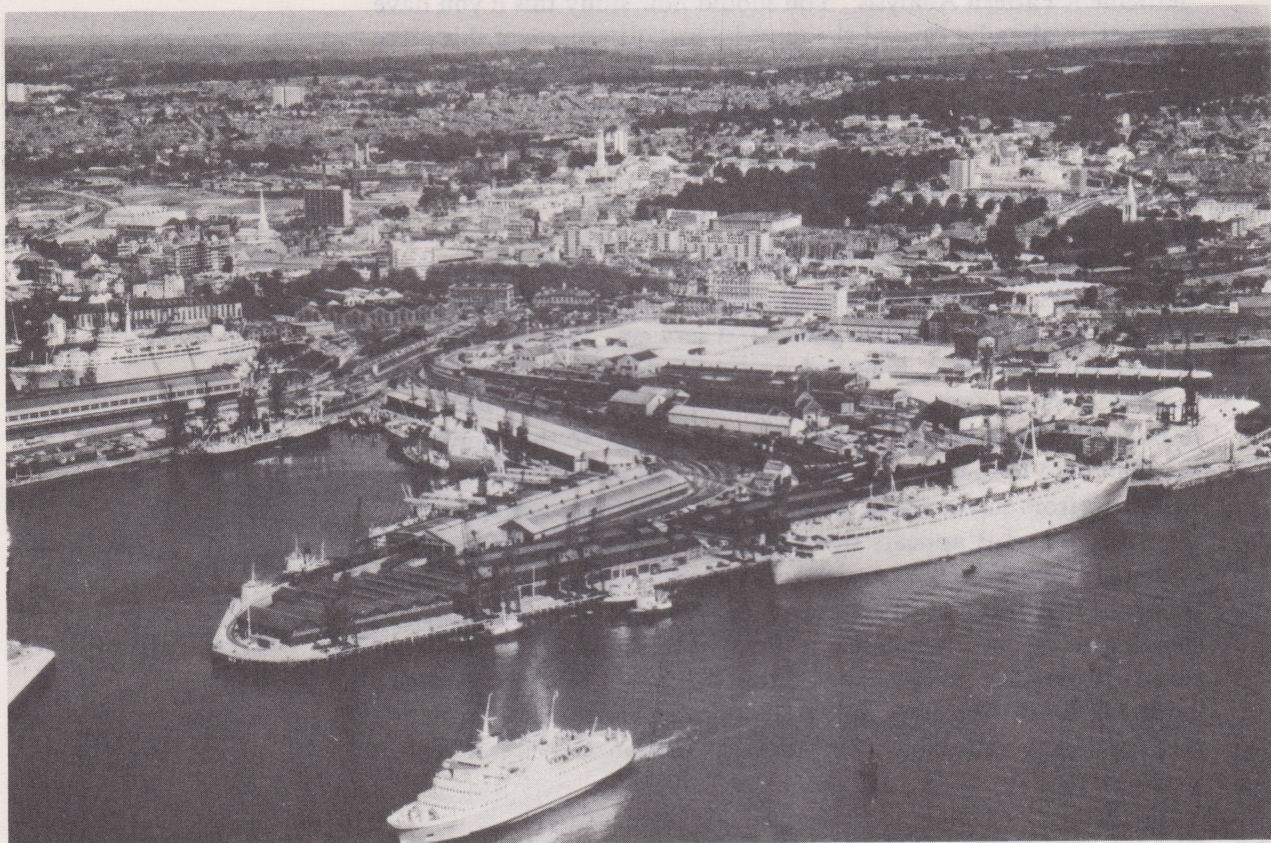


Figure 22.1 Part of Southampton Docks; an aerial view looking north-west.

Transport routes are most influential in governing the location of cities which link regions to external areas. Often the dominating metropolis of a region has had its origin as a transport centre, although later urban growth has attracted so many other functions that this original stimulus to its development has been masked. Many of the great coastal cities of the world provide an example of a location of this kind, lying as they do at the junction of two kinds of transport. But inland cities can also provide examples, a classic case being Chicago, where twenty-one railway systems terminate and meet the Great Lakes waterway.

Urban settlements tend to grow on transport routes only at specific places, particularly at junctions and break-of-bulk points, where one form of transport is changed for another. In fact, there are innumerable locations of this kind – at road and railway junctions, at the head of sea and river navigation, or where a route changes direction and passengers and goods are likely to branch off from one form of transport to another. Hence settlements whose locations are guided by transport routes are found

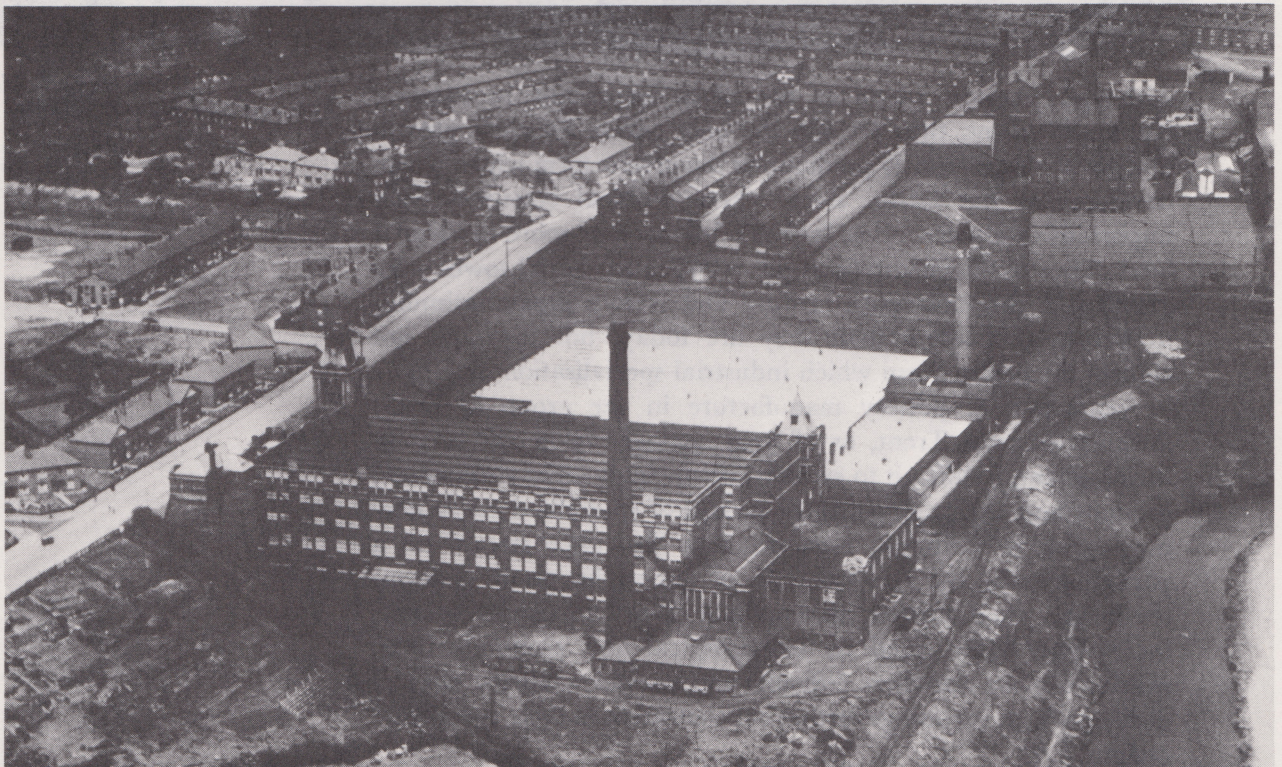
not only at the end of these routes, but also along them. What is important is not the number of routes which come together at a particular point, but the degree to which passengers and goods are interchanged there.

Urban settlements which owe their location to transport facilities possess a variety of functions. Often a line of small local service centres is attracted to a transport route. Or again, some towns mainly provide services for passengers and vehicles moving along transport routes, although settlements of this kind are easiest to pick out in relatively empty areas, where there are no other stimuli for urban growth. Break-of-bulk points are convenient points for certain types of manufacturing, and this in turn provides a reason for urban growth: for example, sugar refining and flour milling are often found at the ports through which the raw materials are imported. A large centre which has been given considerable accessibility by a focus of routes is likely to provide specialized retail and social services; and because of the links such a centre has with the outside world, it is likely to be a focus for wholesale as well as retail trade.

Johnson then turns to the importance of physical factors in determining the size and spacing of settlements with particular reference to the tendency for urban settlements to cluster where perhaps the presence of a particular physical resource is all important (Johnson, 1969 A, pp. 78-9).

These urban clusters tend to grow around some localised physical resource; and often manufacturing is a dominant occupation. In Britain the cotton-manufacturing towns of Lancashire and the woollen towns of Yorkshire provide two examples of this kind of development where a coalfield has been the principal physical resource which located the cluster of towns. Similar examples are common elsewhere in Europe and in parts of the United States.

Figure 22.2 A Cotton Mill at Bury, Lancashire.



Some towns whose location was originally governed by physical resources have functions other than manufacturing. Extensive, sandy beaches, for instance, have supported the development of resort towns. An example of this is provided by the string of resorts found along the coast of Lancashire, of which Blackpool is the best known, but which also includes Lytham St. Annes, Bispham and Cleveleys. Or again, tracts of well-drained land with attractive scenery close to a large metropolis may well encourage the growth of a group of commuter settlements. Some of the towns close to London which are associated with the North Downs may be looked upon as an example of this kind of development.



Figure 22.3 High Street, Guildford; a commuter town south-west of London.

Although physical resources are often important in locating clusters of towns, they are not the only reason for their growth and have not necessarily predestined the precise form which urban development has taken. Even where physical resources were important originally, other factors often become more influential later. Thus coalfields provided power when industrial towns were growing in the nineteenth century and were a greater stimulus to industrial location than they are today, but they did not control the precise form which industrial specialisation took. The concentration of pottery manufacture in the group of towns forming Stoke-on-Trent, or of light engineering in and around Birmingham, is difficult to explain convincingly on environmental grounds and the origin of these groups of specialised cities may owe much to fortuitous circumstances. But once started on a particular path, the very existence of a specialist group of towns encourages their further development. Local industries become increasingly intertwined by technological and economic links, making a move elsewhere difficult; and various ancillary services develop which encourage further concentration in these specialised regions.

In the twentieth century the growth of clusters of urban settlements is more frequently found around large metropolises and results in what are sometimes called 'city regions'. Often these are made up of small country towns and villages which have been drawn into the ambit of a major city and have been enormously expanded as a result. Sometimes this expansion has been undertaken as a result of social policy, as in the 'new' and 'expanded' towns around London, which have been designed to relocate some of the urban expansion which would otherwise have been associated with the continuous built-up area of the Metropolis.

The towns in these city regions are related to one another by

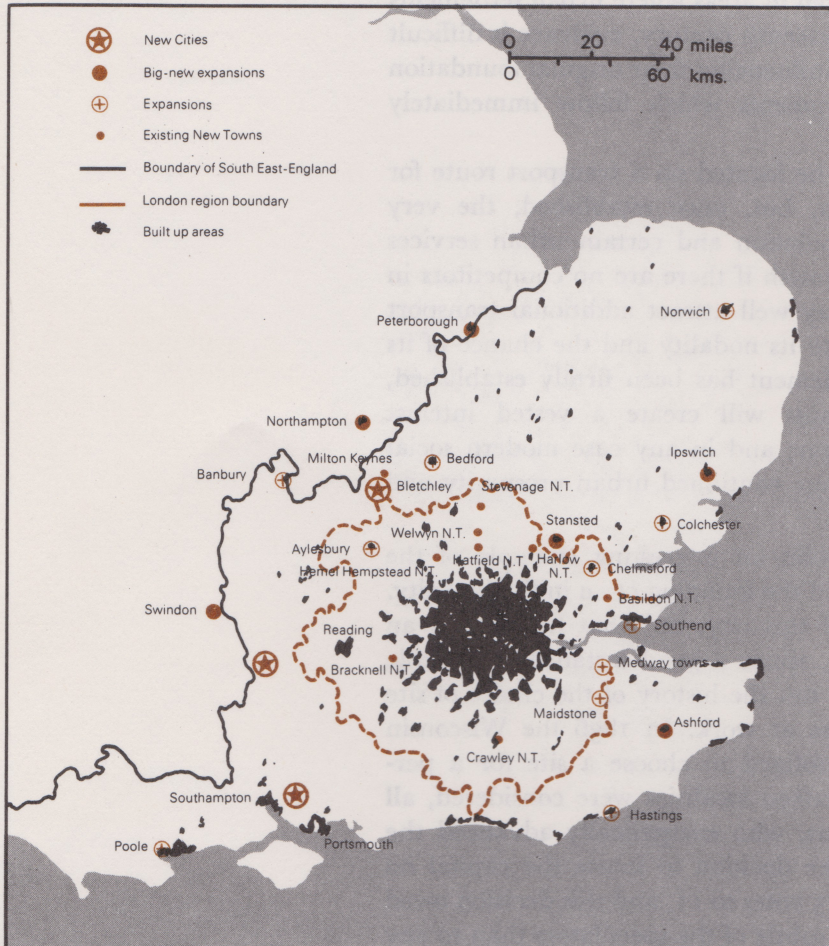


Figure 22.4 New and Expanded towns in the South-East region.

the functions which they perform. Some may form commuter settlements, some may be manufacturing centres, some may be shopping and administrative centres, and some may possess a mixture of functions. But all will be bound together by social and economic links, if not by a continuous built-up area. The groups of towns do not normally show the kind of industrial specialisation which was found in nineteenth-century industrial regions, but rather they are dominated by the so-called 'light' industries. Often these are industries which profit from being near consumers, and often they draw benefit from being near other industrialists whose products and services they use.

This kind of clustering is perhaps best exemplified by the urban development along the north-eastern seaboard of the United States. Here rather special circumstances exist, since there is not one major city, but a line of ports which have spawned other towns around them. The most important factor, however, is the tendency

for modern industrial cities to form clusters, and this has produced in this region the most extensive, highly-urbanised area in the world.

Finally, Johnson (1969 A, p. 79) turns to the influence of whim and chance in the determination of settlement size and spacing.

Although it may be assumed that in numerous cases the detailed location of an urban settlement was guided by the chance decisions of individuals, it is difficult to unearth specific evidence. Often even the date of the foundation of historic cities is lost in antiquity, not to mention any knowledge of the forces which guided the original choice of location. Even in areas where urban settlements have been founded in the nineteenth century, evidence is difficult to untangle, since the factors influencing their original foundation are often hidden by developments which follow immediately afterwards.

For example, a town may be located on a transport route for some quite fortuitous reason, but, once established, the very presence of a nucleus of population and certain urban services tends to encourage further growth if there are no competitors in the vicinity. Such a town may well attract additional transport routes and thus add further to its nodality and the chance of its growth. Once an urban settlement has been firmly established, the fixed capital it represents will create a vested interest against any change of location; and in any case modern social and economic trends encourage continued urban prosperity and growth.

Madison, Wisconsin, provides an interesting example of the actual factors which influenced the founding of an individual city. At first sight the location of this city, on what now seems an accessible and attractive site, seems a good instance of the role of the physical environment; but the history of the choice of site reveals that other forces were at work. In 1836 the Wisconsin Territorial Legislature was obliged to choose a site for a permanent capital. A total of sixteen localities were considered, all of them owned by speculators, who energetically advanced the claims of their own land. The decision to locate the capital on its present site was taken by 15 votes to 11, and this decision owed more to intrigue by the most subtle of the speculators than to any careful assessment of site and situation.

Whim and chance, however, are more important in governing the location of individual settlements than in forming the regional pattern of urban development.

Johnson concludes that most urban areas can only be accounted for by thinking in terms of the interaction of *all four factors* including that of service function, though he is at pains to stress, as with other geographers, the fundamental importance of the service function and therefore Central Place Theory. Bearing this in mind, let us turn to the theory itself.

2.2 Christaller's Central Place Theory Analysed

At its simplest Christaller proposed a scheme in which urban areas or towns with the lowest level of service specialisation would be equally spread across the landscape equidistant from each other. Each would have around it a hexagonally-shaped hinterland or

service area. The way in which this shape is developed is clearly and briefly explained by Ambrose in the *Reader* (pp. 362–5). For every six of these towns there would be a bigger city in which more specialised functions were performed. This would in turn be situated an equal distance from other cities with the same level of specialisation as itself. Such a city would also have a larger hexagonal service area for its own specialised services. Then even more specialised centres would also have their own hinterlands or service areas and be located at equal distances from each other.

Christaller maintained from evidence he had derived in southern Germany that the smaller centres would probably be located seven kilometres apart. Centres of the next order of specialisation, he thought, would serve three times the area and three times the population. For this reason they would be located twelve kilometres apart ($\sqrt{3} \times 7$). In the same way the area of the hinterlands of centres at the next higher level of specialisation would again be three times larger. The table on p. 384 of the *Reader* demonstrates this point. However, the arrangement just described has been called a $k=3$ hierarchy. This is because the number of centres at successively less specialised levels in the urban hierarchy follows what we call a geometric progression (i.e. 1, 3, 9, 27, etc.). Christaller maintained that a hierarchy which showed these features demonstrated what he termed the 'marketing principle'. Here the most important factor influencing the distribution of urban settlements is the need for central places to be as close as possible to the customers they serve. Christaller also put forward other hierarchies. Where the cost of the traffic network is an important factor, a $k=4$ hierarchy is to be expected. Where administrative control is particularly dominant, a $k=7$ hierarchy is more likely. But the basic Christaller theory has been adequately summarised by B. J. L. Berry and A. Pred in their work *Central Place Studies* and simply elaborated by J. A. Everson and B. P. FitzGerald in *Settlement Patterns*. The appropriate extracts from both sets of writers appear in your *Reader* (pp. 366–7 and 368–71), and should now be read.



Figure 22.5 (a) Part of Szechwan, near Chengtu.

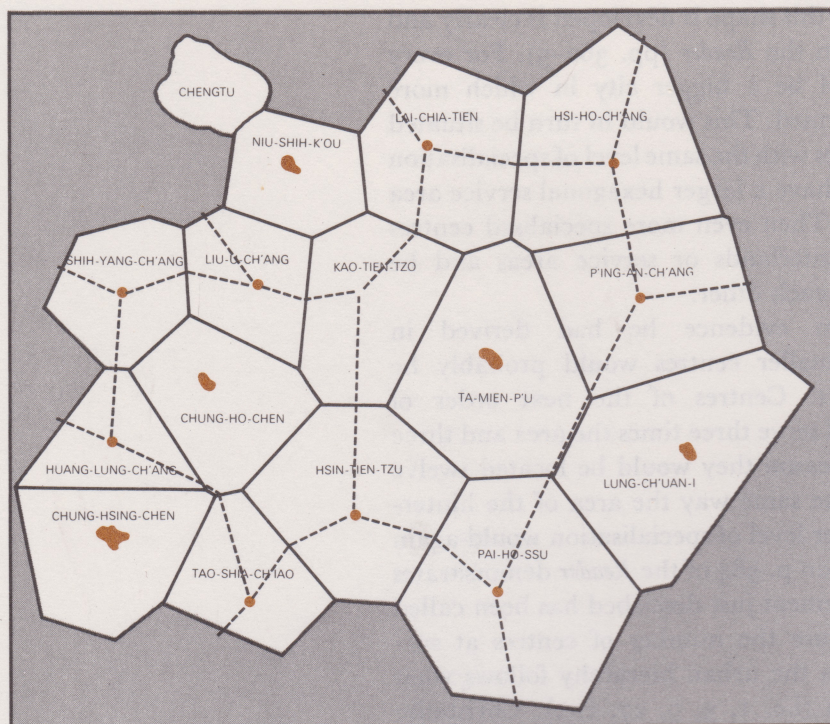


Figure 22.5 (b) First abstraction of part of Szechwan, near Chengtu.

Should the principles set out in these texts seem too theoretical, it is possible to recognise almost perfect examples of a Christaller landscape from the empirical work of G. W. Skinner (1964) in his 'Marketing and Social Structure in Rural China'. Figure 22.5a shows a section of his study in Szechwan, south-east of Chengtu. In this there are two levels of centres shown together with their market areas – Pai-ho-ssu is an example of what Skinner terms a 'standard' market, whilst Chung-ho-chen illustrates the larger 'intermediate' market.

Figure 22.5b is developed by simplifying and straightening out the boundaries of the market areas. The further reduction of this to diagrammatic form in Figure 22.6 gives the perfect $k=3$ network.

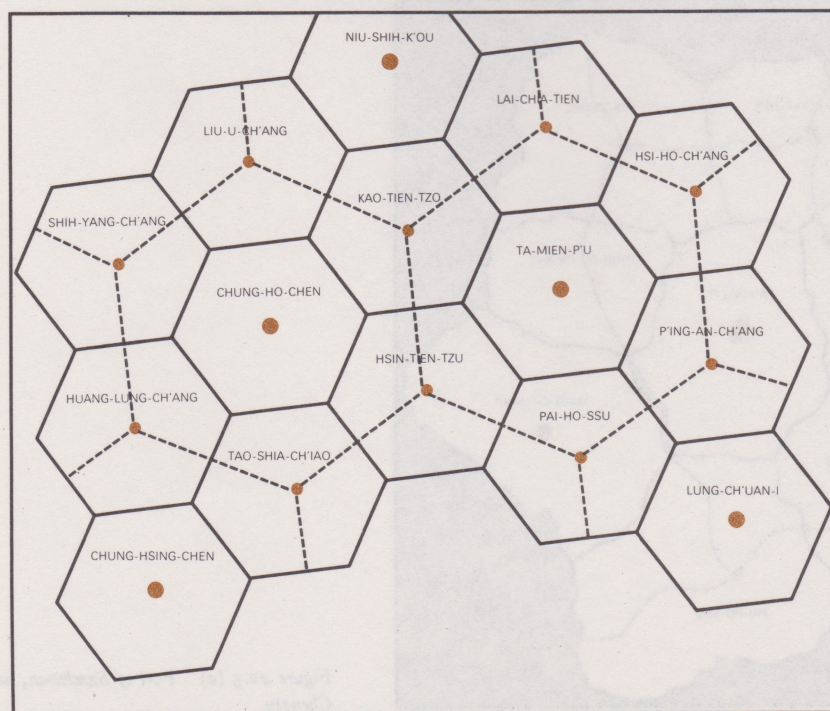


Figure 22.6 The $K=3$ network.

Figures 22.7a to 22.7c further illustrate the application of Christaller's principles, this time in an area of Szechwan lying 35 to 90 kilometres north-east of Chengtu. In this case Figure 22.7c shows a perfect $k=4$ network, except for one empty hexagonal area in the mountains.

Of the various principles set out by Christaller, that of marketing is the one that can most easily be distinguished and the one which has perhaps had the most influence on later workers who have attempted to refine his ideas.

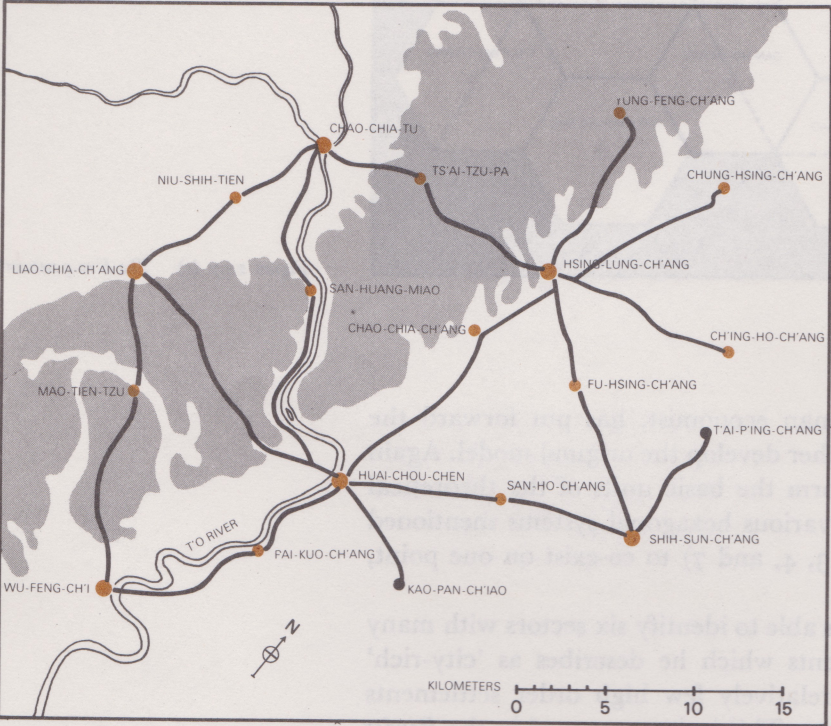


Figure 22.7 (a) Part of Szechwan, north-east of Chengtu.



Figure 22.7 (b) First abstraction of Szechwan, north-east of Chengtu.

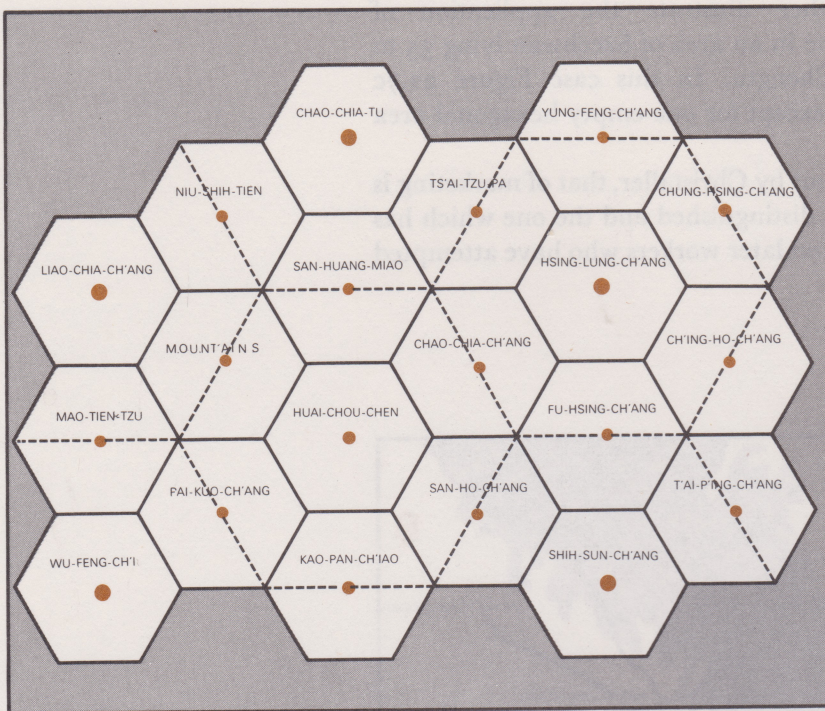


Figure 22.7 (c) The $K=4$ network.

2.3 Refinements to Christaller

August Lösch (1956), a German economist, has put forward the most interesting scheme to further develop the original model. Again the hexagonal service areas form the basic units of the theoretical landscape, but he allows the various hexagonal systems mentioned in the Christaller system ($k=3, 4$, and 7) to co-exist on one point, as shown in Figure 22.8.

Then by rotating them he is able to identify six sectors with many relatively high order settlements which he describes as 'city-rich' sectors and six sectors with relatively few high order settlements which he calls 'city-poor' sectors. This is demonstrated in the *Reader* (p. 375). The arrangement just described does not produce the tiered system of urban centres as the Christaller theory suggests, and as Ambrose so carefully explains on pp. 374–5 of the *Reader*. It leads rather to a continuum of variously-sized urban areas whether they be cities, towns or villages, which he considers approach the real world situation very much more closely. Lösch's continuum versus Christaller's tiered system of urban centres has led to a prolonged discussion amongst geographers as to the relative merits of each proposition. Perhaps the best known piece of research to attempt to carry the argument forward is that of B. J. L. Berry and W. L. Garrison, who were concerned to discover whether the 33 central places in a county in Washington State, U.S.A., fitted into a stepped hierarchy or whether they were in the form of a continuous hierarchical curve. Their conclusion favoured the concept of grouping, or the tiered system, a conclusion endorsed by Ambrose in his comments on this part of their research (*Reader*, p. 384). However, this is a point to which we will return later.

2.4 Concepts of Range and Threshold

More than this, the work of B. J. L. Berry and W. L. Garrison drew specific attention to two factors controlling the distribution of central places which were merely implied in Christaller's original conception.

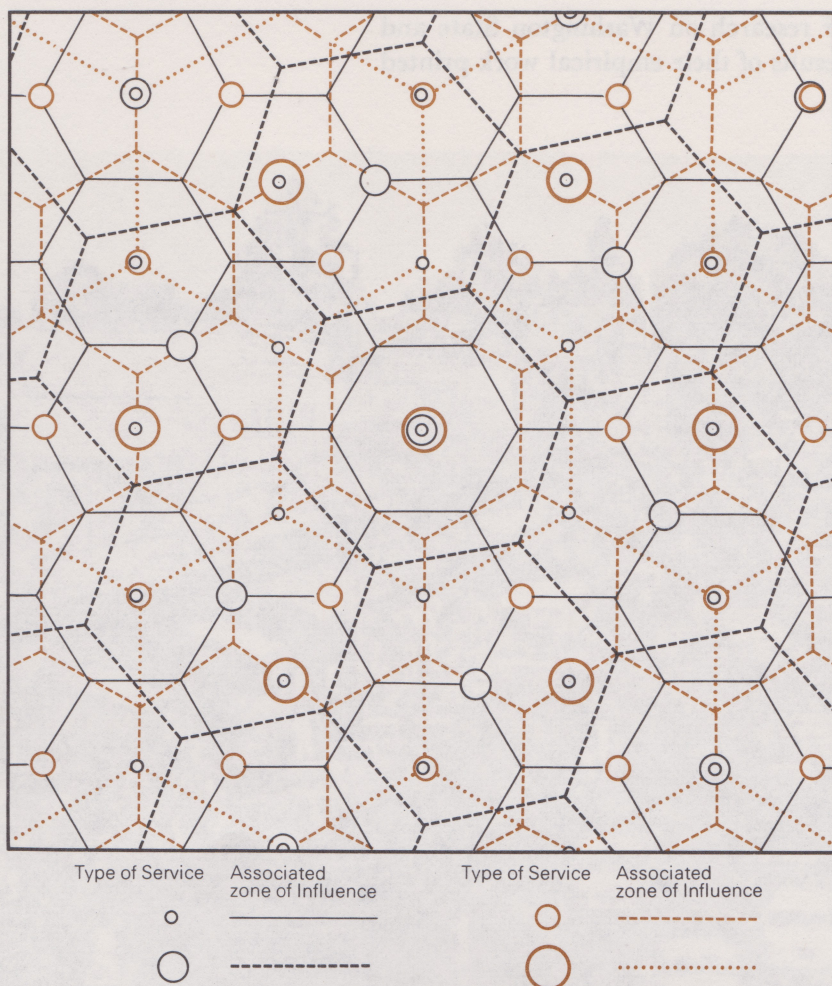


Figure 22.8 Simplified version of Lösch's theory of The Arrangement of Trade Centres.

One of these was the factor which is known as the 'range of a good', which is the distance over which people are prepared to travel to obtain a particular service. The other is the 'threshold', which is the minimum amount of purchasing power necessary to support the supply of a good or service from a central place. These terms should already be familiar to you since you have read the initial commentary on the basis of Central Place Theory by Ambrose in the *Reader*. If you have read further into Chapter 22 you will also recall that he states that the range of a particular service from an urban centre has an upper limit which is determined by competition from other places which supply the same service (*Reader*, p. 371). The range, of course, has a lower limit controlled by the threshold necessary to allow it to function. As a result of the operation of these factors, one would naturally expect a hierarchy of central places. The more specialised services need a larger threshold, but also have a more extensive range and so they are to be found in the larger settlements which provide enough purchasers to support them, whether they be in the urban area itself or in the hinterland. Large centres also provide less specialised services, but as these have a smaller range, it is also reasonable for smaller settlements, lying between the larger centres, to compete without difficulty. Although each individual service may have a unique range and threshold, in practice it must be provided from an urban centre where groups of services are concentrated. As a result, distinctive groups of services will develop in those urban areas which provide about the right threshold for their survival within the range (or zone of influence) appropriate for these services. All these points are well brought out

by Berry and Garrison in their research on Washington State and you should now consider the results of their empirical work printed in the *Reader* (pp. 375–83).



Figure 22.9 Southampton High Street, north of the Bargate.

2.5 Objections to the Christaller Model

Anyone who has read the appropriate chapter in the *Reader* will already be aware of the possible objections that can be raised against Christaller's model of central place distribution. Edward Ullman, one of the earliest commentators writing in English on Christaller's work, questions the originator of the model's measure of centrality, besides other possible distortions of the ideal spatial distribution of central places. These may arise from factors such as accessibility of transport routes, variations in soil, climate, topography and culture. Both he and Ambrose reinforce the statement made earlier in this paper that central places may have other functions besides those of servicing. Ambrose also takes particular exception to Christaller's assumption of the even spatial distribution of population and the idea that the rural dweller will always go to the nearest centre offering the service he seeks. Thus he considers the notion of overlapping rather than abutting hinterlands for central places to be more realistic. J. H. Johnson, whose writing we have already considered in relation to the limited nature of the Christaller model, also has interesting comments to make in critically assessing the model's validity. He begins with the point made by Ambrose concerning the overlap of hinterlands (Johnson, 1969 A, pp. 98–9):

It can be argued that they are the normal state of affairs in any

country with well-developed means of transport although Christaller made the assumption that the hinterlands of towns of similar specialization do not overlap. There is evidence, too, that the presence of a large urban centre tends to discourage the growth of smaller, less specialized settlements nearby, at what would be the appropriate distance according to Christaller's model. There has also been disagreement about the ratio of small centres to settlements at the next level in the urban hierarchy. Another ground for criticism lies in the fact that it is difficult to devise a realistic pattern of communications which would allow an arrangement of superimposed hexagonal hinterlands to function.

When the theoretical scheme is tested against reality additional difficulties emerge. The provision of services does not take place solely from towns which were specifically founded as service centres. Industrial towns, which began their existence without in any way providing for the wants of the surrounding countryside, often develop this function later, thus giving a distorted arrangement of central services. Perhaps this might be looked upon as a special case, which would always be difficult to embody in any theoretical scheme, but in a highly industrialized country it is an important element in understanding the distribution of tertiary activities. One further practical difficulty has theoretical implications. All urban settlements have grown up as a result of an historical process, often in a whole series of different technological situations. But towns founded in the past do not disappear – they continue to function in the present landscape. The American geographer, John Brush, recognized this fact in his study of south-west Wisconsin. Here the first settlements were built when the most common means of transport was by horses and wagon. When railways were built, larger centres developed along the tracks, in some cases on the sites of earlier settlements; and the motor-car is now encouraging the relative growth of other settlements. But the past means of transport can still be picked out in the distribution of the small service centres of this region.

The difficulties encountered by John Brush in his testing of the theoretical scheme against reality are certainly worth more detailed consideration than Johnson gives them in his brief resumé of the research carried out in south-west Wisconsin. For this reason you should, at a convenient moment, read the paper in the *Reader* (pp. 385–92) in which Brush joins forces with Dacey to compare his work in Wisconsin with that of the other writer in southern England.

From this and the other comments made above by Johnson you will appreciate that discrepancies can be expected between the theoretical and the actual distribution of central places, even in areas where physical geography has not had such an important influence on the distribution of population. These discrepancies do not necessarily invalidate discussions of Central Place Theory which, as we have noted, are primarily concerned with the location of service centres in a hypothetical situation where only economic factors are operating. However, what they do stress is that much of this theory refers to conditions to be found in the Western world in the mid-1930s, and that the kind of social and technological change that is taking place in the way we live now may indeed be even leading to changes in the applicability of the model as an explanation of the distribution of central places in terms of their service functions. This is a point to which we shall return later.

2.6 Rank-Size

Meantime, it has to be remembered that Central Place Theory considers not only the spacing of urban areas but also their size – in other words it sets out to provide some explanation of the presence of a varying number of settlements of different sizes with a large number of small towns and a smaller number of larger settlements. For a discussion of this see Auerbach (1913), pp. 74–6, or Zipf (1941). In many areas this arrangement follows what has been called the ‘rank-size’ rule. This says that if the urban settlements in an area are ranked in descending order of population size (from 1 to n), the population of the nth urban settlement will be $\frac{1}{n}$ the size of the larger city. Thus the population of other urban settlements will be arranged according to the series 1, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$,..... $\frac{1}{n}$ which when plotted on a graph appears as follows:

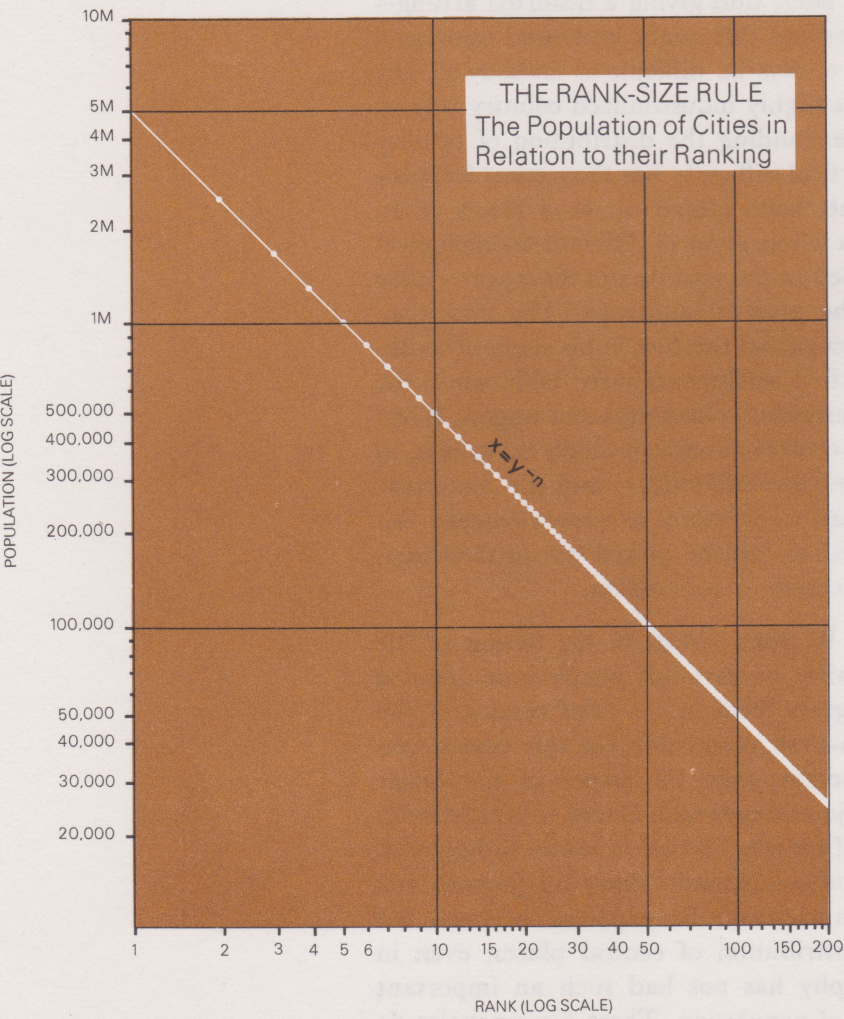


Figure 22.10 The Rank-Size Rule; the hypothetical size of the population of cities in relation to the ranking.

Along with the hypothetical example of a graph worked out in terms of the ‘rank-size’ rule, actual data have been used and the resultant graphs may be usefully compared. Figure 22.11, for example, shows the size and ranking of urban areas in England and Wales for 1961. The diagram is based on the population of the administrative areas of towns and cities as given in the census for 1961. If this is considered alongside the previous hypothetical graph it can be seen that the population of London is larger than the ‘rank-size’ rule would imply it should be.

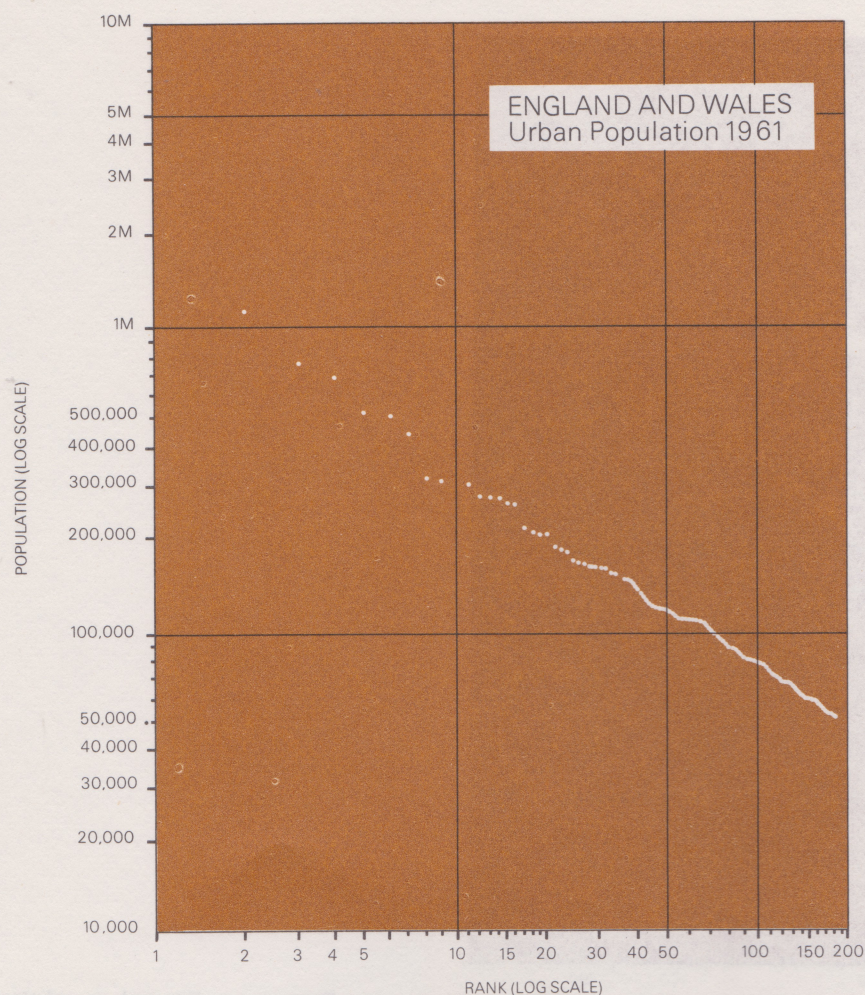


Figure 22.11 The size and ranking of urban areas in England and Wales, 1961.

It is relevant to point out that the real population size in terms of the built-up area we know as London is actually very considerably greater than that of the Administrative County of London shown in this diagram. Certainly the general trend of the rest of the urban settlements is approximately in line with the rule, though it appears less steep than the 'rank-size' rule suggests it should be. One other point should be noted and that is the incidence of clear breaks in the slope of the graph. This and some of the other characteristics of 'rank-size' graphs can be distinguished in another empirically derived set of graphs given by B. J. L. Berry and W. L. Garrison (1959) in their paper on 'urban rank-size relations'.

Why, however, should there be these discrepancies between graphical representations of the rule as they appear hypothetically and those based on observed data? To begin with, it must be remembered that the 'rank-size' rule is not quite the same in concept as Central Place Theory. Although it can be said that Christaller's thinking was essentially stimulated by considering a real area, southern Germany, he was most concerned with producing a theoretical model of what reality should be like allowing for certain basic assumptions. The 'rank-size' rule on the other hand, is essentially empirically derived from a large number of studies. It is for this reason that discrepancies between the two concepts occur and this is why, as we saw a moment ago, the size of the bigger city is often greater than the rule says it should be. All the same, in spite of differences in the conception of the two ideas, there is still a large measure of convergence between them as both suggest a situation where there are, as B. J. L. Berry and W. L. Garrison (1959) point out (p. 230):

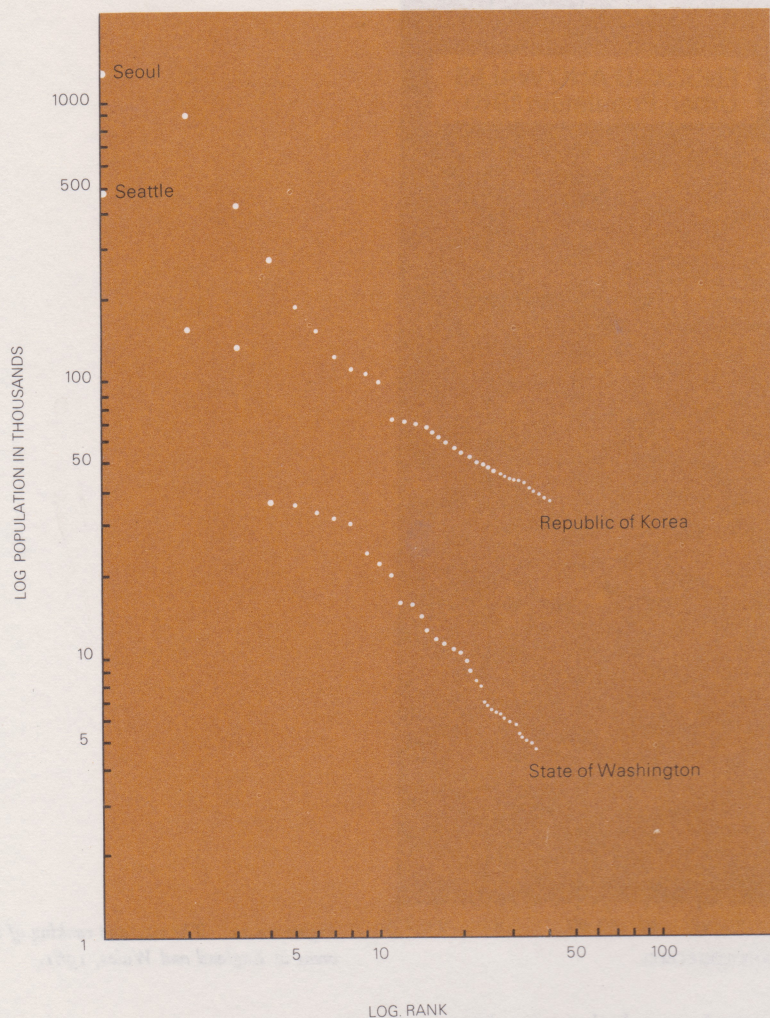


Figure 22.12 City rank-size relationships; Republic of Korea and State of Washington.

many small cities, a lesser number of medium sized cities, and but few large cities.

2.7 The Rank-Size Tiered System versus the Continuum

One major point of divergence remains however. As we saw earlier, Christaller's urban hierarchy would produce a tiered arrangement of urban sizes. On the other hand, the 'rank-size' rule suggests a continuous curve with a smooth progression from rank to rank. Fortunately the discrepancy is not all it seems for the 'rank-size' rule works best when a large area is being studied, whilst the tiered hierarchy is most clearly noted in a much smaller area where manufacturing industries do not predominate – in fact, much like the area studied by B. J. L. Berry and W. L. Garrison in the paper 'The Functional Bases of the Central Place Hierarchy' (*Reader*, pp. 375–83). Thus the discrepancy is primarily one of scale and when a country as a whole is being studied, where the presence of some industry is almost inevitable and variations in the urban hierarchy from area to area due to differences in technology and economic development tend to balance out to some extent, the breaks in the population numbers between the different levels of urban hierarchy become hidden or blurred so as to produce a relatively smooth population curve. M. J. Beckmann (1958) has given support to this conclusion and has written (p. 246):

In summary, we have shown that the empirical 'rank-size' rule as observed by Zipf, is compatible with the ideas on hierarchies of

market areas and their central cities as developed by location theorists.

Perhaps William Bunge (1966) summarises the whole situation perfectly when he writes:

an argument rages as to whether there is in fact a hierarchy of settlements (hamlets, villages, towns, etc), or only a continuum of various sized and functional places. . . . Since Beckmann's theoretical contribution, the importance of this debate has greatly decreased. However, if Christaller is rigidly correct, his fixed k assumption would cause the 'rank-size' distribution of cities to be (1) discontinuous and (2) discontinuous in a systematic fashion. So far the debate centres on the simple discontinuity implication of Christaller. The debate has split between evidence offered for low ranked cities as opposed to high ranked ones. Vining's (1955, pp. 147-95) well taken criticism that the 'rank-size' distribution is continuous, was based on the higher ranked cities. Berry and Garrison (1958, pp. 304-11) ran an unsuccessful experiment on these larger cities. Their experiment was a failure since they fitted a continuous curve to the observed 'rank-size' distribution which could not possibly have fitted the 'rank-size' distribution, if in fact that distribution is a discontinuous step function. Therefore, the continuity of high ranked cities still remains to be validly tested. Cities of the lower order have been tested in a small region for the existence of the hierarchy by Berry and Garrison [as we have already noted in the *Reader*, pp. 375-83], Mayfield (1960) and Berry (1960, pp. 112-16), all using similar techniques and all establishing the local existence of the hierarchy. Notice that this in no way refutes the Beckmann formulation of continuous 'rank-size' distribution for a large economic region as a whole. It may well be that local discontinuous hierarchies blend into a continuous distribution for a country taken all together.

If we accept what Bunge has to say, certainly then, it seems that Central Place Theory provides a convincing explanation of why the population of cities follows the 'rank-size' rule and it stresses the importance of the function of cities as central places in controlling their general size.

2.8 Central Place Theory and Shopping Centre Hierarchies

Since so much of this unit has been devoted to the role of Central Place Theory in a discussion of the size and spacing of settlements, it should perhaps be appreciated that the theory makes an important contribution to the study of the many shopping centres within cities that are big enough to have a complex pattern of retail outlets. Shopping centres exist in a hierarchical form with different levels of retail specialisation which closely, but perhaps not exactly, parallel the hierarchy of towns and cities of different sizes. The earliest study to reveal this hierarchy was that of M. J. Proudfoot in Philadelphia which dates back to 1937. He discovered a ranked order of shopping centres including (1) small clusters of stores, (2) neighbourhood business streets, (3) principal shopping thoroughfares, and (4) outlying business centres, as well as (5) the Central Business District. He considered that this ranked order would be found for the most part in the principal cities of the United States of America. Of these five categories he wrote (1959, pp. 395-7):

The Central Business District represents the retail heart of each city. Here, individually and collectively, retail stores do a greater volume of business per unit area than elsewhere within the city. This areal concentration is manifested by the use of multistoried buildings of which retail stores, for the most part, occupy choice street-level frontage, service establishments are concentrated into upper-storey offices, and residential occupancy is restricted to scattered hotels. Here retail occupancy is characterized by large department stores, numerous women's and men's clothing stores, furniture stores, shoe stores, jewelry stores, and similar outlets selling shopping goods. Added to these, though of subordinate importance, there are numerous drug-stores, tobacco stores, restaurants, and other stores selling convenience goods.

The Central Business District draws customers from all parts of the city proper and from outlying suburbs and nearby incorporated towns. Many people, besides being customers, are likewise employed in the various commercial and service occupations which constitute the complex of human activity within this district. To serve this movement of purchasing and working population to and from residential areas, all modes of intra-city transportation are focused here. This district, therefore, experiences extreme traffic congestion during the workday and more particularly during the morning and late afternoon 'rush hours'. The personal inconvenience of this congestion, and the commutation cost in time and money all have favored the development of the outlying business center, catering to the shopping-goods wants of the outlying population.



Figure 22.13 Philadelphia, U.S.A., 1937.

The outlying business center represents in miniature, the same type of retail structure characterizing the Central Business District. The center possesses a marked areal concentration where closely spaced retail stores do a volume of business exceeded only by those of the central district. Here, for the most part, are found

shopping-goods outlets such as women's and men's clothing stores, furniture stores, shoe stores, jewelry stores, one or more large department stores, and an admixture of convenience-goods stores. Although individual outlying business centers do not draw customers from all parts of the city, they frequently attract them from long distances. Since these centers depend on customers drawn from wide areas, they all have developed at focal points of intra-city transportation where pedestrian traffic is increased by passengers of mass and vehicular conveyance.

The principal business thoroughfare is characterized by the co-existence of two related attributes. It is both a business street and a traffic artery. As a business street it possesses large, widely spaced shopping and convenience-goods stores. As a traffic artery it carries a heavy density of mass and vehicular traffic. This dense traffic primarily results from attractive forces exerted on residential population by the Central Business District or some outlying business center. Although stores of this structural type cater to, and are primarily dependent on, customers derived from this dense traffic, their presence has little counter-effect on the density of the traffic. Offering the special inducement of ample curbside parking space, these stores manage to thrive by attracting customers from a small fraction of the passengers of this inter-community traffic.

The neighbourhood business street is primarily of neighbourhood significance. It draws customers, almost without exception, from easy walking distances. This structural type consists of more-or-less continuous rows of grocery stores, meat markets, fruit and vegetable stores, drugstores, and other convenience-goods outlets, interrupted by a minor admixture of shopping-goods stores. These streets extend through residential portions of the city and take the form of a more or less regular network following the principal mass of transportation and trucking routes which are undesirable for residential purposes; are extensions to outlying business centers; or are isolated from other retail structures.

The isolated store cluster is the final, and individually the least significant, type of retail structure. These clusters usually comprise two or more complementary rather than competitive convenience-goods stores. Thus, there may be a drugstore, a grocery store, a meat market, a fruit and vegetable store, a delicatessen and possibly a small lunchroom grouped together at a minor street intersection. These stores usually supply a large portion of the immediate convenience-goods wants of residential families located within easy walking distance. Frequently these store clusters develop in sparsely settled fringes of the urban area, but in many instances they are found within densely populated residential areas, restricted, by the chance of occupancy or by zoning regulations, to a scant block or even a city lot.

Proudfoot's retail structure is of course now rather dated, and must be recast in terms of the growth of new shopping centres focused on the motor car. Nonetheless, the application of the concepts taken straight from the Central Place Theory include those of the 'range of good' (cf. range of a service) and the 'threshold', still remain valid. This will be demonstrated in the radio programme covering this unit where the parallel between the ranked order of shopping centres and the hierarchical structure of urban settlements will be

critically examined. Meantime, these ranking ties may be broadly summarised through the reproduction of J. A. Everson and B. P. FitzGerald's adaptation of H. Carol's table, which offers a comparative study of central places and shopping centres within a city based on evidence from Christaller (Germany), Switzerland and Great Britain.

TABLE 1
A hierarchy of central places

General hierarchy	Special hierarchies for the highest level of central function			Centres within a city	
	Entire settlements				
	Christaller (Germany)	G.B. scale	Switzerland scale	Scale for Zürich centres	Scale for G.B. centres
First Lowest		Roadside hamlet (Chippenham)	Dorf	Local business district	Local centre
Second Low order	Marktort	Village (Old Buckenham)	Marktort	Neighbourhood business district	Neighbourhood centre
Third Middle order	Amtsort Kreisort Bezirksort	Town (Thetford)	Stadt	Regional business district	Community centre
Fourth High order	Gauort Provinzhauptort	City (Norwich)	Grossstadt		Regional centre
Fifth Higher order	Landstadt	Metropolis (Bristol)	Metropole	Central business district	Metropolitan centre
Sixth Highest order	Reichsteile	Super Metropolis (Manchester)			Super metropolitan centre
Seventh World wide order	Reichstadt	World metropolitan centre (London)			

(Based on diagram in *Settlement Patterns*, p. 92. J. A. Everson and B. P. FitzGerald (1969), London, Longmans.)

In essence, we see therefore, that Central Place Theory can on the one hand refer to spatial distribution in a large area which is made up of urban settlements and rural zones (i.e., it deals with the size and spacing of settlements in the rural landscape) and on the other hand, the spatial distribution of a small area which is essentially made up of shopping centres.

Edwin Thomas (1967) in *Metropolis on the Move* spells this out (pp. 36–7) in an interesting way, but he postulates the recognition of two central place theories:

The first one is essentially Walter Christaller's original construct and a number of variations that have arisen. The basic idea in Christaller's initial model refers to the shaping, size and number of an agglomeration of certain kinds of non-agricultural goods and services – services that are best offered in the midst of their consuming group, hence, the word central. When there is a mix of these central services and goods, we define a central place in keeping with this original concept and talk about the agglomerations of these mixes and their resident populations as central places or sometimes just urban places, depending on the kind of study we are trying to execute. The important thing to note here is that we are talking about a problem that can be reduced to between-city relationships in some form. Here we have a very large area which includes a number of different urban entities, or urban places. We identify a discrete spatial distribution – a set of agglomerations that is identifiable – and then we proceed to analyze this particular spatial distribution within the context of an articulated set of ideas.

The second central-place theory is a modification of Christaller's and, in some sense, the change is merely a simple matter of scale. Instead of dealing with a large area and central goods and services that focus in an urban place, this theory is concerned with a small area – a city itself. Central goods and services, within this context, represent mixes that arise in things like shopping centers, neighbourhood size, community size and so forth. The important thing to note here is that we are talking about conditions within an urban area rather than relationships between urban areas.

As far as Central Place Theory is concerned in making a contribution to the study of shopping centres within cities, doubt has been expressed by writers like Johnson (1969B, p. 192) concerning its continued validity with the imminent rise of the more dispersed urban structure. To some extent he takes the view of B. J. L. Berry (1967) who in his *Geography of Market Centres and Retail Areas* says that (p. 124):

modern transportation and rising real income have removed the tyranny of distance and people's life spaces (the areas in which they travel to work, shop, socialise or use for recreation) have widened immensely. Shopping centres no longer dominate an immediate exclusive market area; instead several centres serve the same community-of-interest area and consumers at the same time visit all of them.

More particularly however, Johnson is alluding to the rapid growth of residential areas at the periphery of urban centres that appears increasingly to be a characteristic of economically developed societies, such as those of north-west Europe and the United States of America. Thomas, whom we quoted above, has particularly made a study of Central Place Theory in relation to these urban growth areas (or areas of urban sprawl as he prefers to call them) and probably explores the matter as far as it is possible to do so at present. He makes the point that this form of urban growth makes it difficult to define the extent and location of a central place and that further, this problem must therefore affect not only within-the-city studies to which Johnson refers, but also the between-city studies in the large areas. Thomas adds that (1967, p. 40):

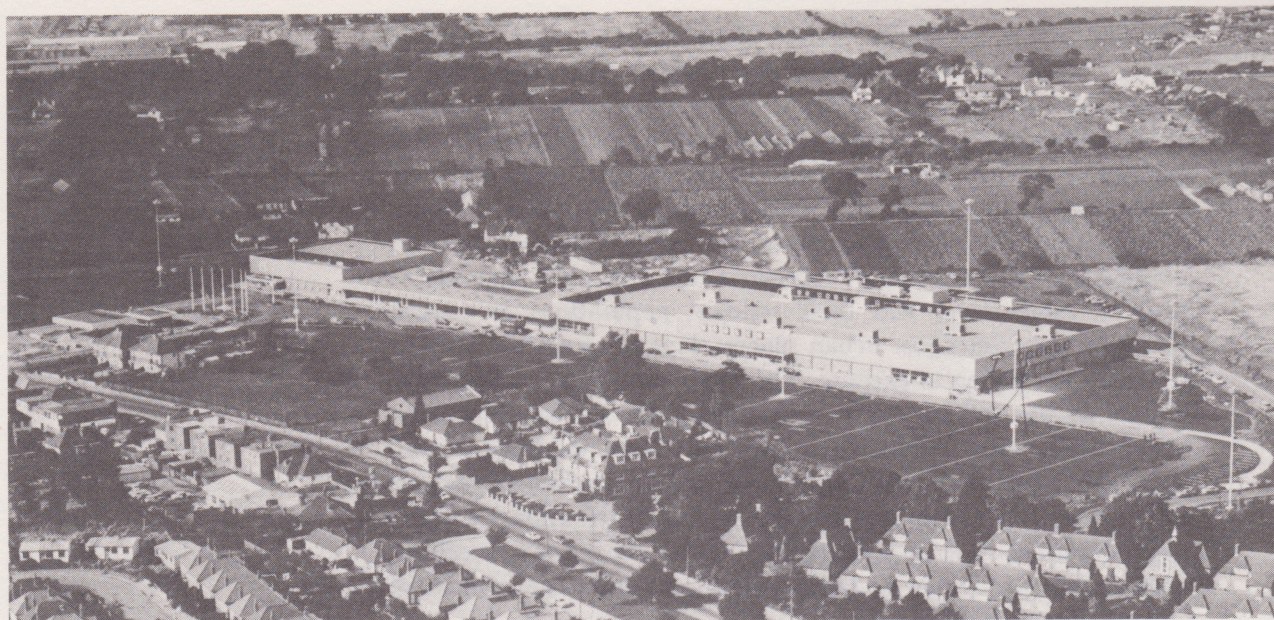


Figure 22.14 New developments in shopping; a precinct built amongst new housing areas on the outskirts of Bournemouth.

the problem of definition arises when we study either 'within' or 'between' relationships at one time or, if we try to make a sequential study of how central-place tertiary economic activity relationships may change through time. Thus urban sprawl definitely has an effect at one point in time and this effect is exerted on both kinds of central-place study.

Thomas also draws particular attention to what he calls the behavioural effect of sprawl on Central Place Theory (pp. 40-1):

When sprawl occurs, there is a certain amount of demand for goods and services near the periphery created by the outward residential sprawl. When this demand reaches a sufficient level, it is fulfilled in some formal way. In the expanding city, this is usually by a shopping center of some size. Whether it is essentially neighbourhood size, or community size or full-grown regional shopping center is quite beside the point; there is some definite action taken. Once the action is taken, a behavioral pattern begins among the basic consumer units – the families that are heretofore unserved or poorly served. These people then allocate their purchasing effort to a shopping center – they form a pattern. But there is also a readjustment. The people that were there before (not the new residents) now have an additional alternative. This is an alternative that vies for their purchasing effort and there is a shift – a re-allocation of behavior – which in turn can affect other forms of land use – can affect traffic on highways and a multitude of customer loyalties and attitudes.

To be specific, in Phoenix there were two large regional shopping centers: Park Central and Cristown. In Cristown, Montgomery Ward and J. C. Penney were the two major department stores; in Park Central we have Diamond's and Goldwater's. A large competing shopping center called Thomas Mall is being built now in the north-eastern section of the metropolitan area. In this new center are to be located another branch of Diamond's, which is one of the major department stores in Park Central, and another Ward's one of the major department stores in Cristown. Now, the central-place question resulting from this new sprawl arises: how are undeclared people near Thomas Mall going to

respond to this nearby center which satisfies their needs more locally? A new within-city pattern of central place will emerge. It will be interesting to try to find out what are the spatial and temporal parameters that affect this behavior and to discover how long it will take these people to become oriented to Thomas Mall. But, more to our point, how long will it take the people who are now closer to Thomas Mall – but who used to go to Park Central to Diamond's – to focus on Thomas Mall and how long will it take the people who are closer to Thomas Mall that used to go go Ward's in Park Central to focus on Thomas Mall? It is laboratory situations such as this that may prove to be illuminating.

Thomas concludes (pp. 41–2) by considering the future of urban sprawl in relation to Central Place Theory:

Urban sprawl, because it is in itself a dynamic concept, is going to force Central-Place Theory to be more dynamic. First, because of sprawl, Central-Place Theory must be more interested in central-place relationships as they develop through time and in the establishing of temporal parameters. Second, and this may be most important of all, to handle urban sprawl we are ultimately going to see a Central-Place Theory that does not deal with aggregates, with entire trade areas, but with the family behavioral unit in an attempt to examine a more basic spatial interaction model that involves two points, rather than a point and an area, which has been the concern of Central-Place Theory to date.

Perhaps the closing words Thomas uses takes us too far into the future. For the present he has rightly admitted (p. 39) that:

Whether the concept of central place does or does not fit all cases particularly well is not so important as that the theory describes the right set of formal connections existing between such things as the hierarchy of shopping centers, the concept of threshold populations or threshold demands, or the whole idea of the trade area. Central-place gives us a structure which we can use to evaluate the results of empirical studies. It also gives us a formal structure which we can employ if we want to design research on the problems of the spacing, distribution, size and number of tertiary or central economic or quasi-economic activities within a large metropolitan area.

To this we must add that whilst the fully developed central-place system with its hierarchical structure is not often found in reality, the consideration of such a theoretical situation allows a clearer understanding of the social and economic relationships which exist between urban and rural areas and between urban areas at various levels in the hierarchy, and, as Johnson says (1969 B, p. 192):

without the complications provided by the uniqueness of every place on the earth's surface.

This general dictum concerning the value of the central-place model is equally applicable to all the models used in the preceding three units, as should be only too apparent if the narratives in Units 19–22 have been truly effective.

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ILLUSTRATIONS

Aerofilms, Figs. 22.1, 22.2; University of Chicago Press, Fig. 22.12 in *Readings in Urban Geography*, ed. H. M. Mayer and C. F. Kohn; Duke University, North Carolina, Figs. 22.5a, 22.5b, 22.6, 22.7a, 22.7b and 22.7c, in *Journal of Asian Studies*, Vol. 34; J. W. Kitchenham Ltd., Bournemouth, Fig. 22.14; Longmans, Table 1 in J. A. Everson and B. P. Fitzgerald, *Settlement Patterns*; Pergamon Press, Fig. 22.8 in W. Isard, *Location and Space Economy*, and Figs. 22.10 and 22.11 in J. H. Johnson, *Urban Geography*; Southern Newspapers Ltd., Fig. 22.9; United States Information Service, Fig. 22.13; Weidenfeld and Nicolson, Fig. 22.4 in P. Hall, *The World Cities*; Thomas Wilkie & Co., Fig. 22.3.

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Notes

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